THE EFFECT OF POSTURE, EXERTION AND OTHER AGENTS ON THE CIRCULATION.

Thesis for M.D. Degree, January 1913.

by

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(M.B., C.H.B., Edinburgh, July 1906.)

C O N T E N T S.

I THE EFFECT OF POSTURE ON THE CIRCULATION.

The effect of Posture on the Circulation, has engaged the attention of many writers, and it is not surprising that the results should vary in so many instances, when we consider the changes and variations the pulse may undergo from moment to moment.

The weight of evidence seems to point to an average increased rate of about 15 beats per minute in changing from the recumbent to the erect posture; but it is all important that the age of the patient should be taken into consideration, as that materially affects the results.

Guy (1) examined 100 cases whose average age was 27 . 24 and found a difference in pulse rate of 12 . 28 between the recumbent and erect postures. Stephens (2) finds that the average blood pressure increases in the standing, sitting and supine positions respectively, while the pulse rate decreases in the same order. The average age of his patients was 24 years.

Posture most markedly affects the pulse round about the ages of from 17 - 30 and if Guy's patients had been restricted to children under 16 or to patients over 50 he would probably have found a smaller variation, and under similar conditions Stephens might have come to other conclusions.

While some authorities maintain that the Systolic Pressure augments in changing from sitting

to standing, others maintain that the reverse is the case: but I have no doubt that both are correct and that the only difference is a difference in the average age experimented with.

The subject is referred to more or less fully in the writings of Graves, McKenzie, Janeway, Goldwater, Huchard, Leonard Hill, Hirschfelder, Broadbent, Edgecombe, Oliver, Guy, Stephens, Knox, Barber Cabot & Bruce, Keyt, Nicholson, Allbutt, Gibson, Gubb, and in these writings innumerable references are made to the work of other observers who have studied the subject.

In my observations I have made use of Dudgeon's Sphygmograph and Oliver's Sphygmometer and in the interpretation of the tracings I have accepted the general view that

(1)

1a

1(b)

fig 1 a. represents high tension and 1 b. low tension.

It has been stated that an observer can so manipulate his Sphygmograph that he can arrange any form of tracing to prove his contention: but I have always endeavoured to let the Sphygmograph demonstrate for itself without any assistance. Besides, the great proportion of the tracings were taken by the

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Sphygmograph attached to the McKenzie Polygraph, so that successive observations were made without a change of paper or of pressure, and in any case I had taken a tremendous number of the tracings before I knew what I wanted to prove.

We shall now examine the Pulse variations found in the sitting erect and recumbent postures, and in the order named the observations were generally carried out.

As a general rule I have found a considerable reduction in Systolic Pressure and Pulse rate in changing from the erect to the Recumbent posture, and this tallies with the opinions of most observers.

In some cases the Systolic Pressure is as high, or higher in the recumbent than in the erect posture and in these cases the pulse is reduced very slightly, or may even increase in rate in assuming the recumbent posture.

Huchard (3) and other French writers look upon "stability" of the pulse as a sign of Hypertension and in such cases expect that the pulse rate shall not decrease in rate or shall even increase in assuming the recumbent position. But though this is often one of the signs of Hypertension it is not strictly fair to deduce from this, as Huchard does, the rule that patients whose pulse rate suffers little change on change of posture, are suffering from Hypertension.

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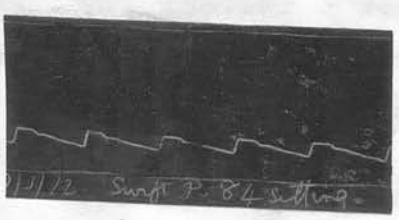
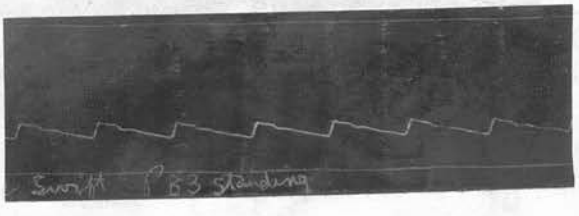
Many cases with quite low tension show very little postural variation, and the reason is that their Systolic Pressure is as high or higher sitting as standing.

Though the Systolic Pressure usually falls on lying down, yet in some cases, especially in the very debilitated the Systolic Pressure rises and the pulse rate falls on assuming the recumbent posture. The pulse then becomes fuller and stronger, and Graves (4) believed that the pulse was stronger in the horizontal than in the erect position.

In considering the effects sitting and standing have on the pulse, I have usually found that when the Systolic Pressure falls on standing, the pulse rate rises: but that when the Systolic Pressure remains the same or increases on standing, the pulse rate suffers slight change. This is not absolute, but is in accordance with Marey's (5) views that the pulse rate is slowed by raising the arterial pressure and hastened by lowering it. The following Sphygmograms exemplify stability of the circulation and show very slight change in any posture:-





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POSTURE.

In what follows S.P.P. will be understood to refer to Systolic Pulse Pressure: D.P.P.to Diastolic Pulse Pressure, and P. to the Pulse.

Fig.2 male Age 60.

Pulse sitting 90	P. standing 92	P.lying 85
S.P.P 150	S.P.P 145	S.P.P 150
D.P.P 80	D.P.P 90	D.P.P 70

& on another date

P.sitting 84	P. standing 83
S.P.P 140	S.P.P 140
D.P.P 75	D.P.P 80.

(3)

Fig.3 male age 85.

P. sitting 86	P. standing 86	P.lying 80
S.P.P 180	S P P 180	S P P 180
D P P 60	D P P 60	D P P 75

(4)

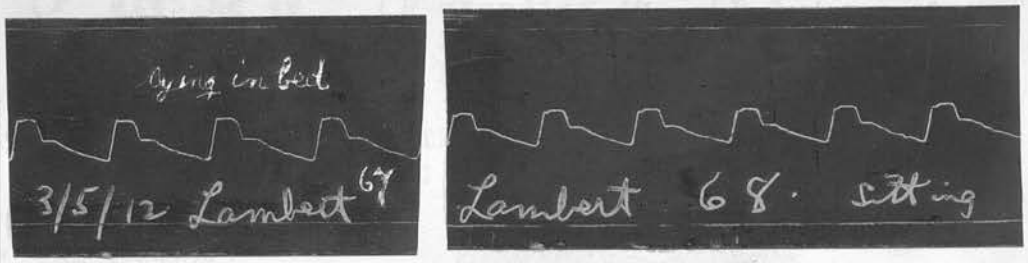

Fig.4. male age 61. convalescing and still in bed after an attack of Subacute Rheumatism lasting 3 weeks. Though he shows no variation between sitting & lying he showed considerable postural variation after getting up. See fig--- 67

Pulse lying 67	Pulse sitting 68
S.P.P 120	S P.P 120
D.P.P 70	D P P 70

POSTURE

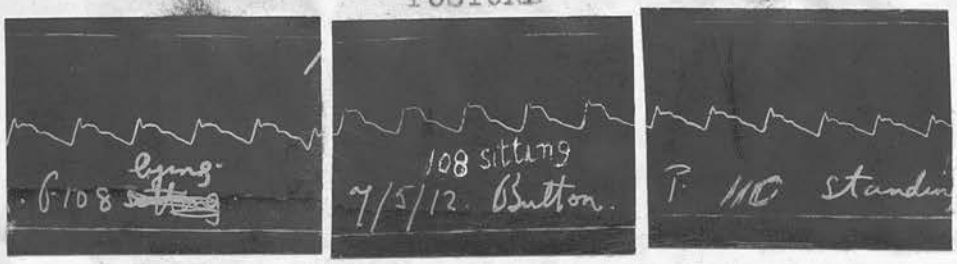

Fig.5 Female age 75 : very debilitated and in bed when these observations were made.

P. sitting	108	P. standing	110
S P P	140	S P P	130
D P P	80	D P P	80

She shows very little change of rate in all postures and yet I don't think a patient of her age with a Systolic Pressure of 140 is suffering from 'Hypertension.' In her case as in many debilitated old patients I have noted a reduction in S P P on standing without the usual and corresponding increase in pulse rate.

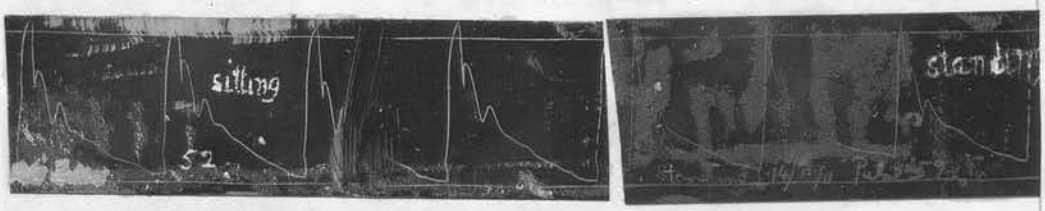

Fig.6 Male age 72. Hypertrophy of Heart: Aortic Systolic Murmur : arterio-sclerosis: Apex of Heart 4½ inches from mid line.

P sitting	48	P standing	48	P lying	48
S P P	145	S P P	145	S P P	150
D P P	65	D P P	65	D P P	55

& on another occasion
P 52 sitting: 52 standing & 52 lying.

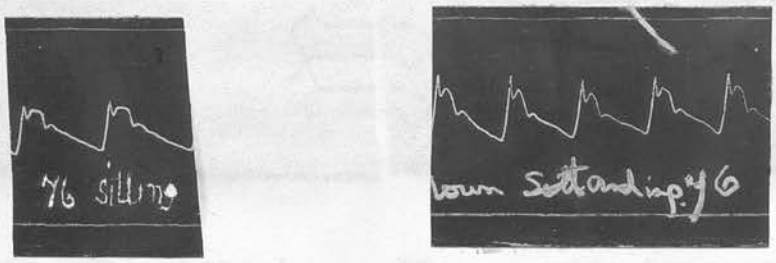

Fig. 7

P sitting	76	P standing	76
S P P	200	S P P	200

& on another occasion
Sitting 75 : Standing 77 : lying :83 :75 :77.

POSTURE

Fig. 7 contd.

In her case the S P P of 200 induced several small punctate Haemorrhages on the arm and I determined in future never to force the pressure beyond 200: for if a pressure of 200 is able to induce small Haemorrhages, a pressure of 250 and over might induce a more serious Haemorrhage where the Blood vessels are very brittle.

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Fig.8 male age 65: arteriosclerosis.

P sitting 92	P standing 89	P lying 87
S P P 190	S P P 190	S P P 185
D P P 105	D P P 110	D P P 105

9

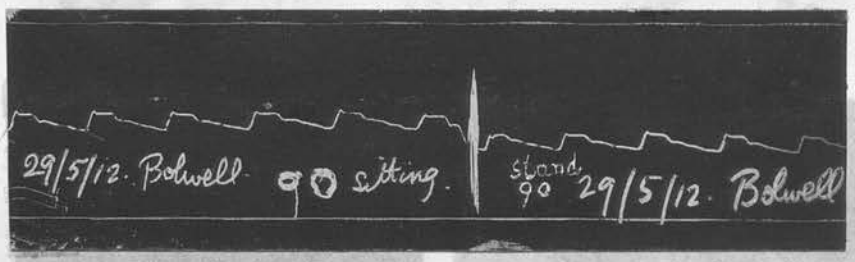

Fig 9. Female age 75 : Chronic Bronchitis : aortic Systolic murmur.

P sitting 90	P standing 90	P lying 93
S P P 200+	S P P 200+	S P P 200+
D P P 100	D P P 110	D P P 110.

10

Fig. 10 Male age: 68 : aortic Systolic murmur: Heart failure: apex 4¾ inches from mid line and oedema of legs.

P sitting 84	P standing 84	P lying 82
S P P 210	S P P 210	S P P 205
D P P 130	D P P 135	D P P 115

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Fig. 13 Female age 83 has been in bed for a year.

P lying	96	P sitting	112
S P P	170	S P P	170
D P P	105	D P P	105

Though the S P P is the same in both positions, yet the systole on sitting, as shown by the Sphygmogram is more sudden and less sustained. After sitting up for some time the tone of the arterial pressure improves as shown above.

14.

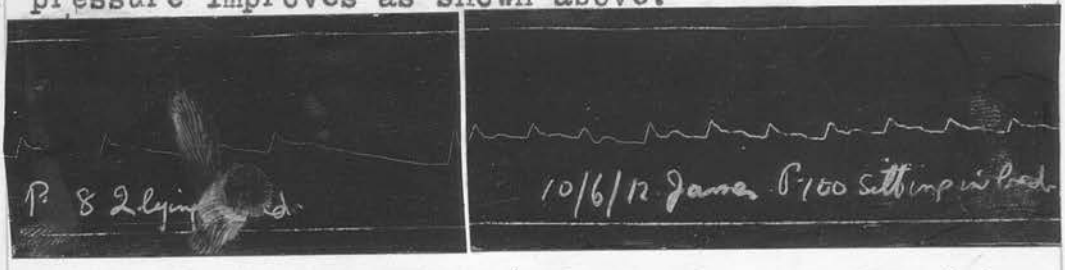

Fig. 14 Male age 29 just convalescing from Lobar Pneumonia, but still in bed. Note the frequent "intermissions" on lying. On sitting up in bed the tension of the pulse is reduced and the rate is much faster.
Nine days later and after getting up P 82 sitting 102 standing, and 9 days later still P 90 sitting: 96 standing.

Here follow some statistics of rate & pressure of the pulse in the various postures.

(1) Where there is less than 10 beats per minute difference between the recumbent and erect postures.

Age	Sex	Pulse Rate. Sitting	Standing	Lying	Pulse Pressures. Sitting	Standing	Lying
80	M	80	80	75	S P P 160 D P P 120	S P P 160 D P P 130	S P P 160 D P P 115
65	M	72	74	70	S P P 165	S P P 170	S P P 160
66	M	76	80	72	S P P 110 D P P 85	S P P 115 D P P 75	S P P 110 D P P 85
60	M	90	92	85	S P P 150 D P P 80	S P P 145 D P P 90	S P P 150 D P P 70
72	M	48	48	48	S P P 145 D P P 65	S P P 145 D P P 65	S P P 150 D P P 65
65	M	86	86	82	S P P 135 D P P 80	S P P 150 D P P 95	S P P 155 D P P 95
85	M	86	86	80	S P P 180	S P P 180	S P P 190
61	M	68		67	S P P 120 D P P 70		S P P 120 D P P 70
75	F	90	90	93	S P P 200+ D P P 100	S P P 200+ D P P 110	S P P 200+ D P P 110

POSTURE

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(P lying	96	(P sitting	112
(S P P	170	(S P P	170
(D P P	105	(D P P	105

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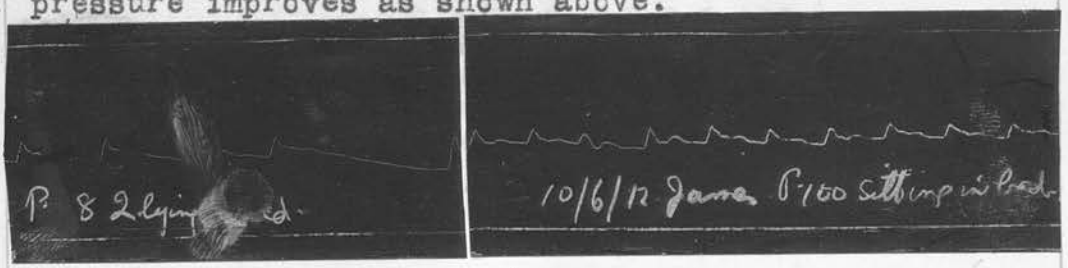

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(1) Where there is less than 10 beats per minute difference between the recumbent and erect postures.

Age	Sex	Pulse Rate. Sitting	Standing	Lying	Pulse Pressures. Sitting	Standing	Lying
80	M	80	80	75	S P P 160 D P P 120	S P P 160 D P P 130	S P P 160 D P P 115
65	M	72	74	70	S P P 165	S P P 170	S P P 160
66	M	76	80	72	S P P 110 D P P 85	S P P 115 D P P 75	S P P 110 D P P 85
60	M	90	92	85	S P P 150 D P P 80	S P P 145 D P P 90	S P P 150 D P P 70
72	M	48	48	48	S P P 145 D P P 65	S P P 145 D P P 65	S P P 150 D P P 65
65	M	86	86	82	S P P 135 D P P 80	S P P 150 D P P 95	S P P 155 D P P 95
85	M	86	86	80	S P P 180	S P P 180	S P P 190
61	M	68		67	S P P 120 D P P 70		S P P 120 D P P 70
75	F	90	90	93	S P P 200+ D P P 100	S P P 200+ D P P 110	S P P 200+ D P P 110

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Statistics contd.

Age	Sex	PULSE RATE. Sitting	Standing	Lying	PULSE PRESSURES. Sitting	Standing	Lying
65	M	92	89	87	S P P 190 D P P 105	S P P 190 D P P 110	S P P 185 D P P 105
62	M	66		62	S P P 150 D P P 100		S P P 140 D P P 95
69	F	75	77	77	S P P 180	S P P 180	
75	F	108	110	108	S P P 140 D P P 80	S P P 130 D P P 80	
68	M	84	84	82	S P P 210 D P P 130	S P P 210 D P P 135	S P P 205 D P P 115
38	M	79	86	81	S P P 155 D P P 95	S P P 160 D P P 95	S P P 160 D P P 90

Note the maintenance of a high Systolic Pressure in all postures.

(2) Cases where there is a difference of 10 or more beats between the recumbent & erect postures; and where the difference is very marked it will usually be found that the S P P (sitting) falls on standing.

Age	Sex	PULSE RATE Sitting	Standing	Lying	PULSE PRESSURES. Sitting	Standing	Lying
56	M	88	106	82	S P P 135 D P P 80	S P P 130 D P P 90	S P P 120 D P P 75
80	M	86	96	84	S P P 170 D - - 110	S P P 160 D - - 125	S P P 160 D - - 100
64	M	94	100	90	S - - 130 D - - 105	S - - 115 D - - 95	S - - 120 D - - 100
30	M	92	100	86	S - - 180 D - - 60	S - - 200 D - - 85	S - - 170 D - - 65
45	M	73	78	68	S - - 150 D - - 70	S - - 150 D p p 75	S - - 130 D - - 65
71	M	86	98	82	S - - 145 D - - 90	S - - 155 D - - 100	S - - 145 D - - 80
75	M	82	90	78	S - - 160 D - - 95	S - - 170 D - - 105	S - - 145 D - - 85

POSTURE

Statistics contd.

		PULSE RATE.			PULSE PRESSURES.		
Age	Sex	Sitting	Standing	Lying	Sitting.	Standing.	Lying.
52	M	78	78	66	S p p 115 D - - 65	S p p 120 D - - 70	S P P 110 D - - 50
64	M	88		80	S - - 135 D - - 80		S - - 105 D - - 65
38	M	109	117	94	S - - 140 D - - 90	S - - 135 D - - 105	S - - 125 D - - 90
55	M		82	72		S - - 155 D - -105	S - - 150 D - - 90

(3) The next three patients were very debilitated and the S P.P rises on lying and the pulse rate is also greatly reduced.

Age	Sex				Sitting	Standing	Lying
18	M	76	87	67	S P P 105 D P P 75	S P P 100 D P P 85	S P P 110 D P P 75
46	M	111	114	100	S - - 120 D - - 95	S - - 120 D - - 100	S - - 135 D - - 95
76	M	82	92	78	S - - 125 D - - 80	S - - 115 D - - 90	S - - 140 D - - 105

The difference found in the Pulse in changing from Sitting to Standing.

We will first deal with Pulses that show no change or not more that 5 beats per minute in changing from sitting to standing. The noticeable fact in such cases is that they usually have either the same Systolic Pressure in both positions, or a rise of pressure on standing, and the Sphygmograms illustrate this: Although Stephens (2) does not comment on the fact, it will be found that in his results those patients who show little postural change have usually a rise in Systolic pressure on standing.

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Fig. 15. Female age 50. Anaemia.

P Sitting	84	P Standing	84
S P P	125	S P P	130
D P P	70	D P P	70

16

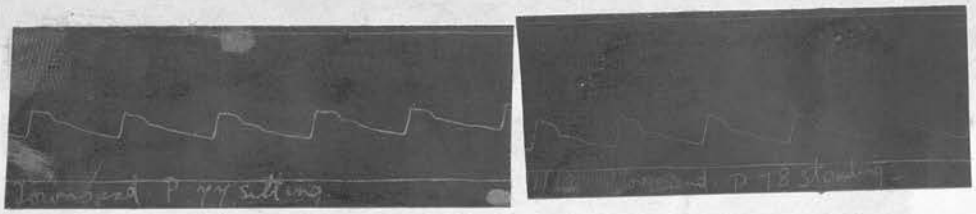


Fig. 16. Male age 69

P Sitting	77	P Standing	78
S P P	145	S P P	145
D P P	80	S P P	90

17

a

b

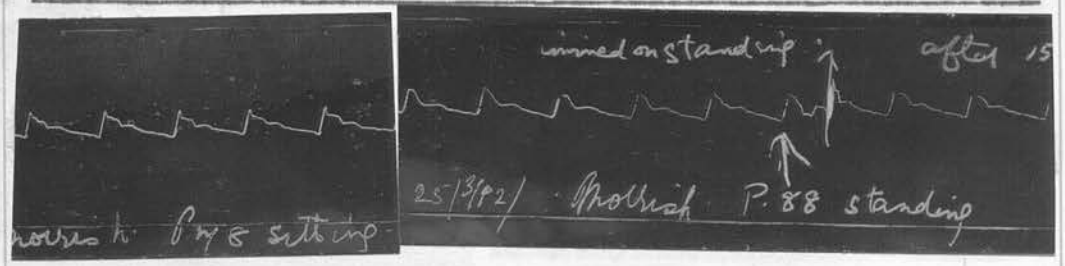


Fig. 17 Male age 55

P Sitting	68	P Standing	70
S P P	140	S P P	150
D P P	90	D P P	100

Fig. 17. b. was taken immediately after recovering from an attack of Bronchitis and shows a greater

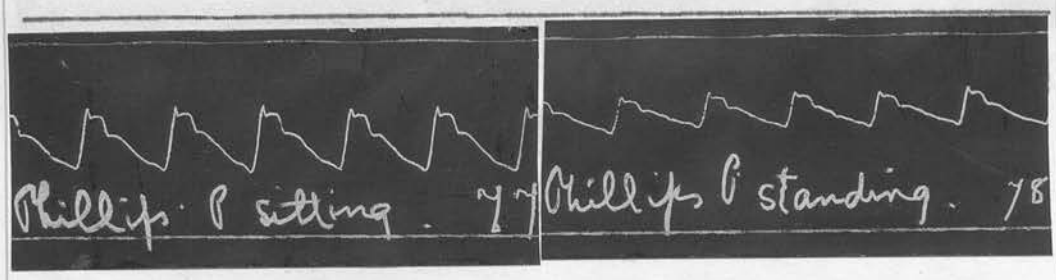
POSTURE

Fig. 17. b. contd.

postural variation and fall of pressure on standing than does Fig.17.a which was taken about 14 days later.

18

a.



b.

Fig. 18.

Female age 69 Bronchitis.

P	Sitting 77	P	Standing 78
S P P	140	S P P	140
D P P	85	D P P	85

And again 3 months later there is little change in rate or in pressure 72 Sitting 72 Standing (fig. 18 b.)

19

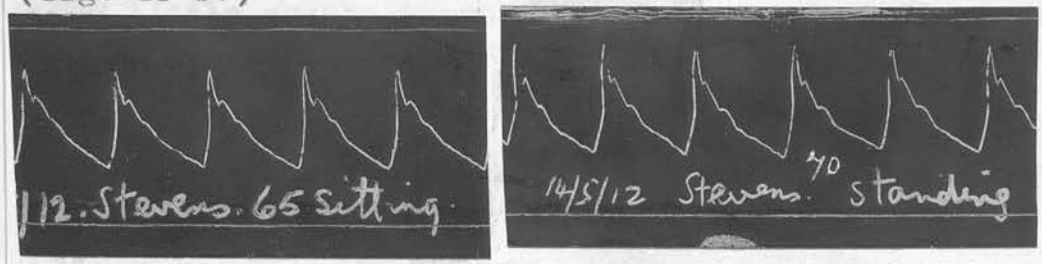


Fig. 19. Male age 79. Patient has just recovered from an attack of Heart failure. Mytral Systolic murmur: Apex 4 inches from middle line.

P	Sitting 65	P	Standing 70
S P P	150	S P P	150
D P P	75	D P P	75

POSTURE

20

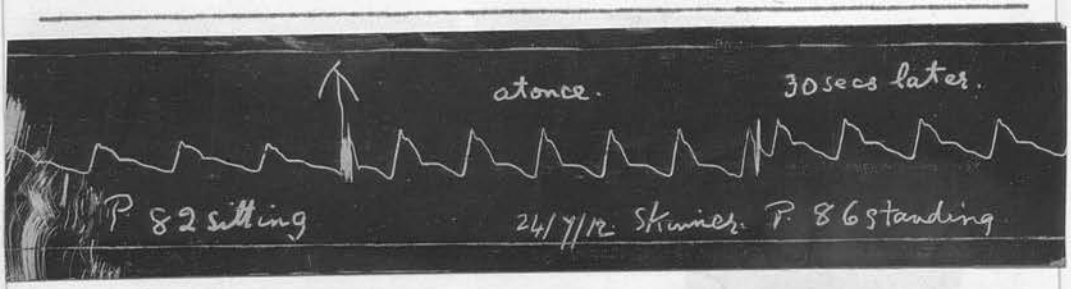


Fig. 20 Male age 38 (note the rise of pressure ½ min. after standing up).

P	Sitting 82	P	Standing 86
S P P	130	S P P	140
D P P	100	D P P	100

21

Fig. 21. Male age 36.

P	Sitting 76	P	Standing 77
S P P	145	S P P	145
D P P	100	D P P	95

In the above cases 15 - 21 the Systolic Pressure was under 160. In all it will be noted how little change there is in rate or in pressure on standing. They show well marked "Stability" of the pulse and yet are not cases of Hypertension.

22

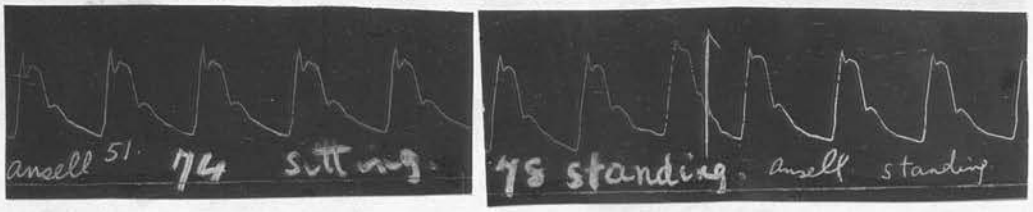


Fig. 22. Female age 51.

P	Sitting 74	P	Standing 78
S P P	160	S P P	170
D P P	80	D P P	80

POSTURE

23

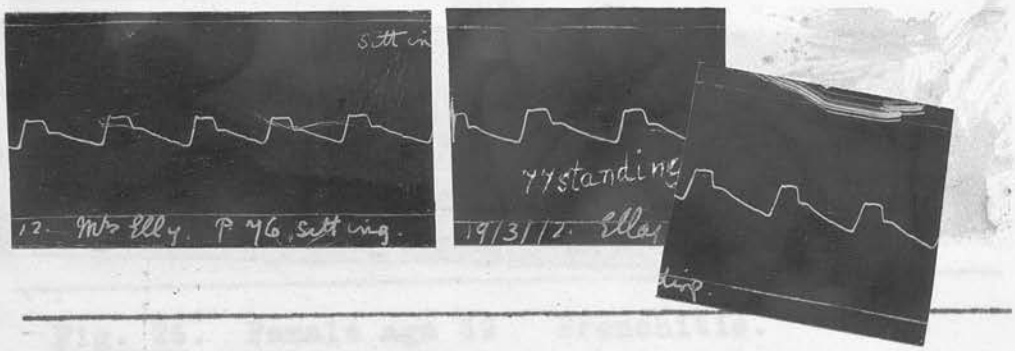


Fig. 23 Female age 62.

P.Sitting	76	P.Standing	77
S P P	170	S P P	180
D P P	110	D P P	110

24

Fig. 24. Male age 75
Mitral Systolic Murmur, and dilated & Hypertrophied Heart

P.Sitting	81	P.Standing	81
S P P	190	S P P	190
D P P	120	D P P	130.

25

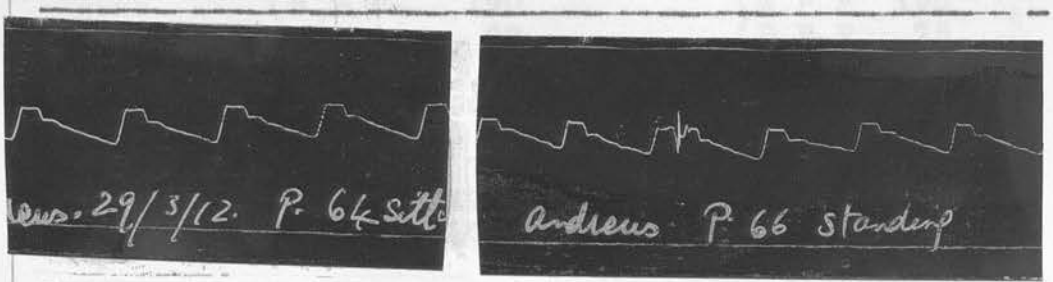


Fig. 25. Male age 75. Arteriosclerosis.

P.Sitting	64	P.Standing	66
S P P	180	S P P	180
D P P	100	D P P	110

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Fig. 28. Male age 68. : aortic systolic murmur & hypertrophied Heart.

P.Sitting 66	P.Stand 66
S P P 220	S P P 210
D P P 130	D P P 130

In all the above cases 22 - 28 the Systolic Pressure was 160 & over and they all show great stability of the circulation.

The following series of pulse tracings demonstrate the absence of marked pulse change of any kind whatever.

29.

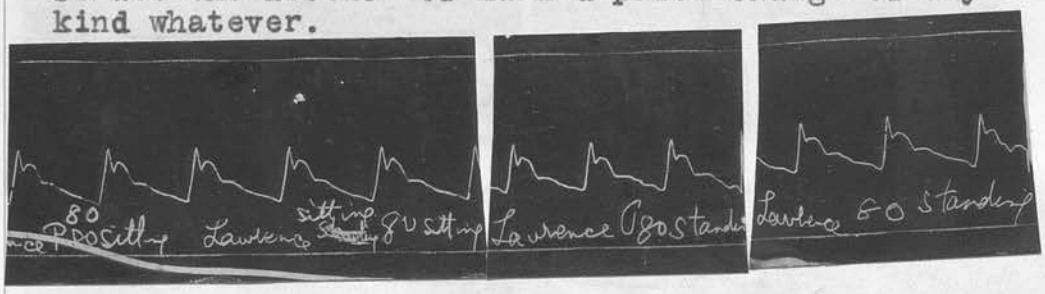
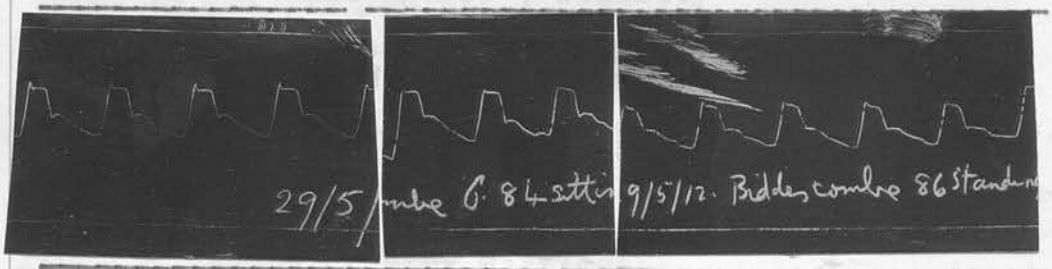


Fig. 29. Male age 43. Aortic Incompetence. The tracing would not suggest this : but the pulse is not splashing and the second sound is heard at the 2nd.Right Costal Cartilage and it is only at the bottom of the sternum that the diastolic aortic murmur can be heard. He had Rheumatic fever when he was 13.

30



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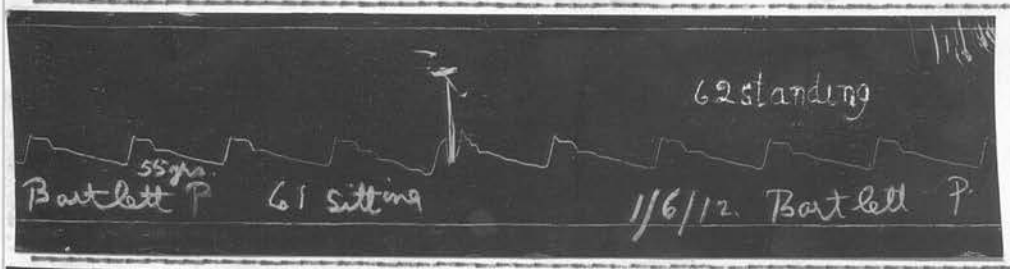
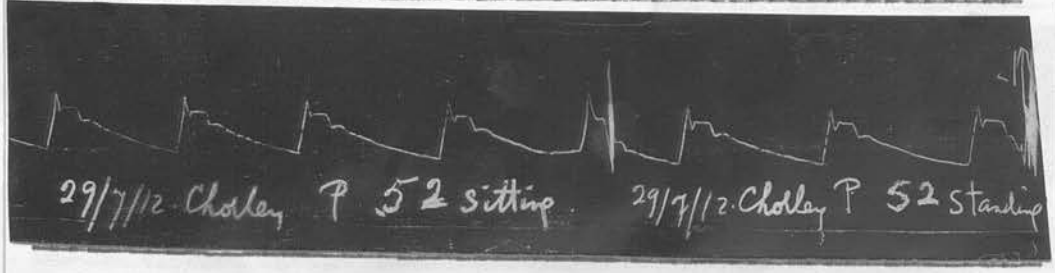
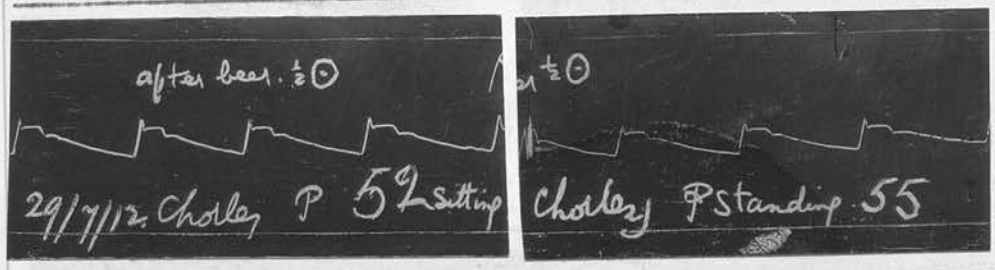


32 (a)

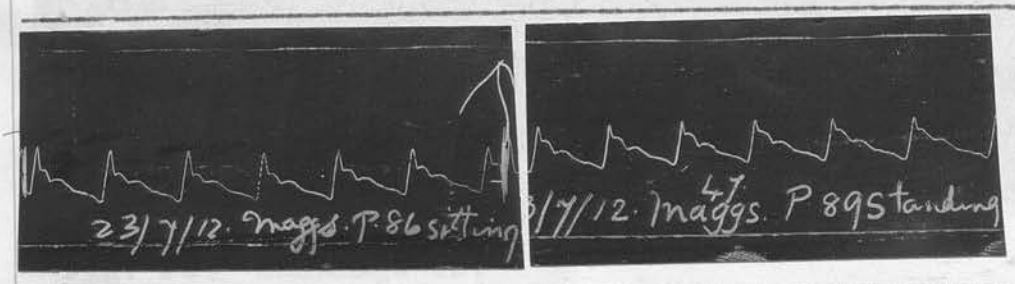


POSTURE

32 (b)



33



34

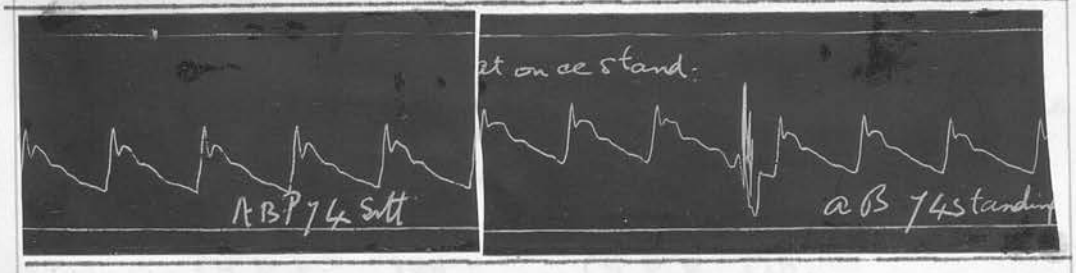


Fig. 30 Female age 84 : Cardiac asthenia

Fig. 31 Female age 55 : Debility

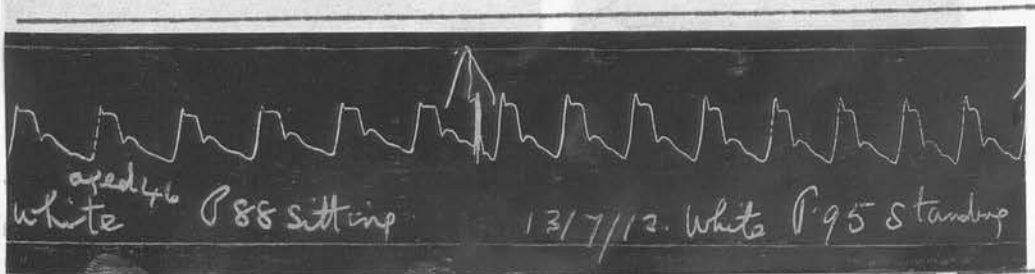
Fig. 32 Male age 69 : Arterio Sclerosis. Both tracings show a very well sustained pressure.

Fig. 33 Male age 47 : An alcoholic and has occasional cardiac attacks.

Fig. 34 Male age 47.

The following have a moderate rise of rate of about 6 - 8 beats.

35



POSTURE

39.

Fig. 39 Male age 17.

P. sitting	106	P. stand	106
S P P	135	S P P	140
D P P	75	D P P	80

40

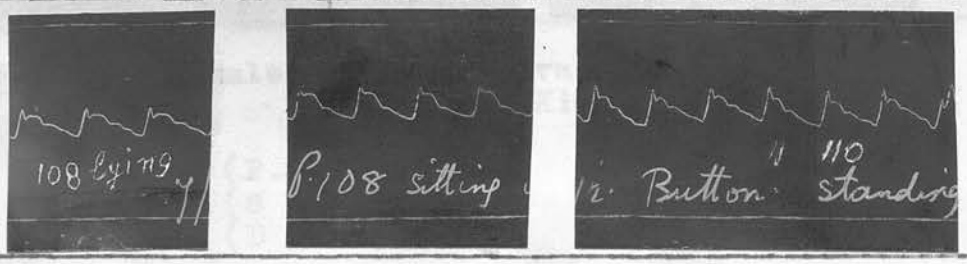


Fig. 40 Female age 75 very debilitated.

P. sitting	108	P. stand	110
S P P	140	S P P	130
D P P	80	D P P	80

41

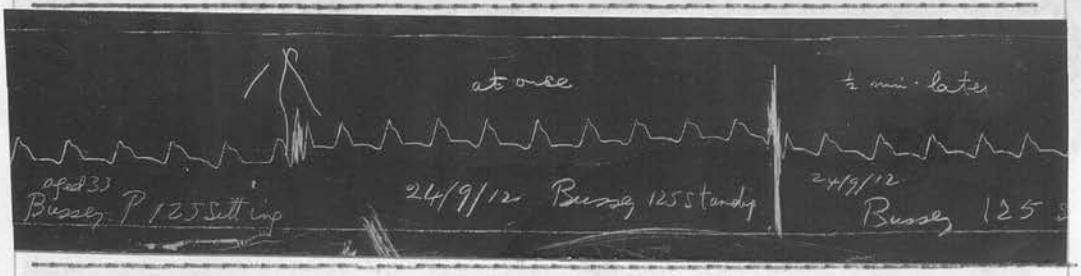


Fig. 41. Male age 33. Pulmonary Tuberculosis.

P sitting	115	P. stand	120
S P P	110	S P P	110
D P P	75	D P P	80

& also Sitting 125 : Stand 125.

42

POSTURE

Fig. 42 . Male age 78 : Cardiac Debility.

P.sitting 96	P.stand 96
S P P 110	S P P 115
D P P 75	D P P 75.

43

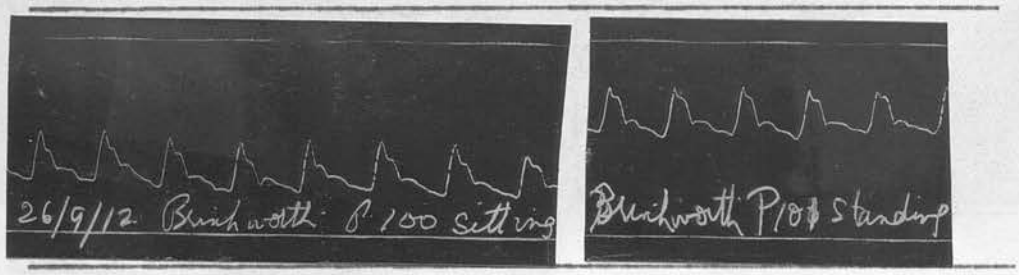


Fig. 43. Female age 59. Advanced Carcinoma of Kidney.

P.sitting 100	P.stand 101
S P P 120	S P P 120
D P P 75	D P P 80.

44

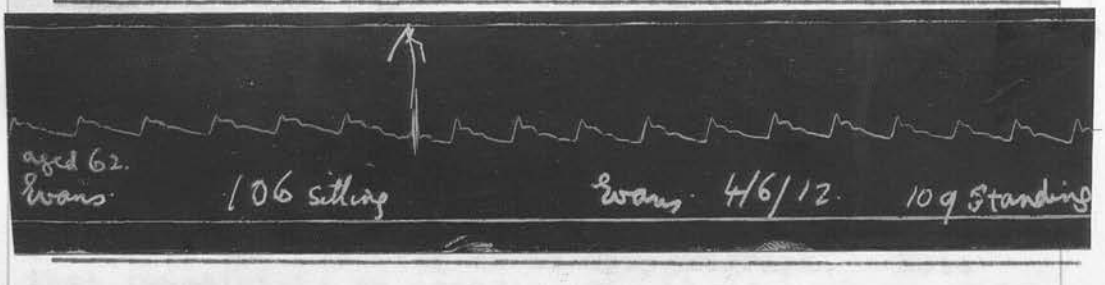


Fig. 44. Female age 62 : Cardiac dilatation & oedema of legs.

45

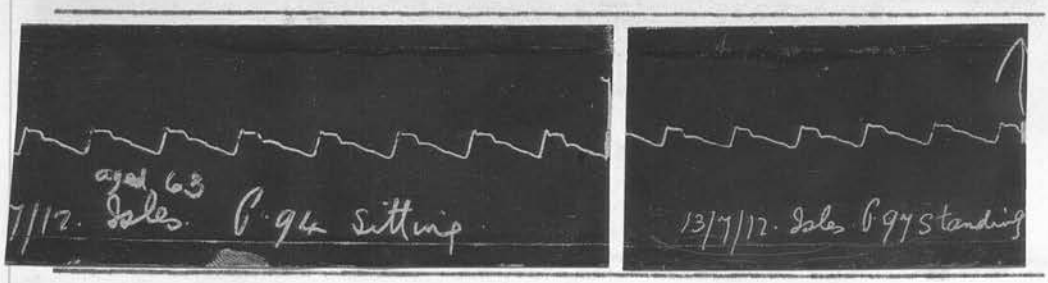
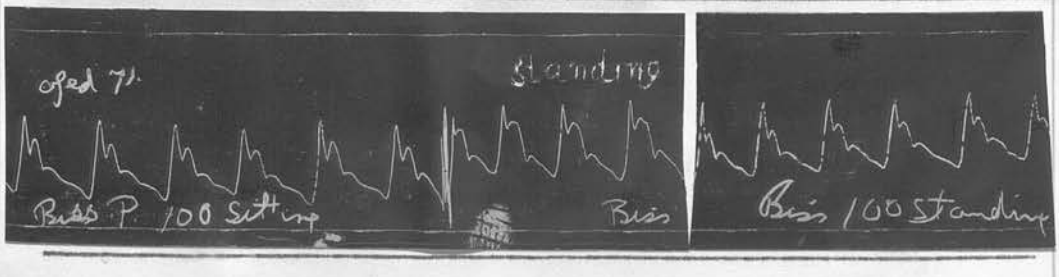


Fig. 45. Female age 63. Debility.

46.



POSTURE.

Fig. 46. Male age 71.

He walked hard in to the Dispensary, and his pulse then was 120 sitting: 120 standing & after 20 minutes rest 100 sitting : 100 standing as above.

47

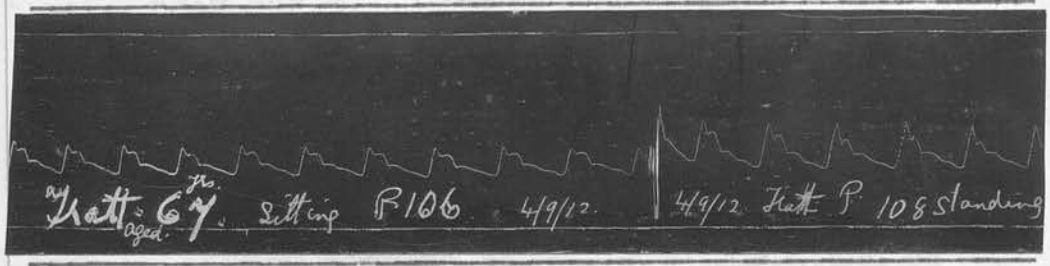


Fig. 47. Female age 67.

Immediately after walk of 2 miles P.110 sitting : 120 standing & after resting 106 sitting : 108 standing as above.

48

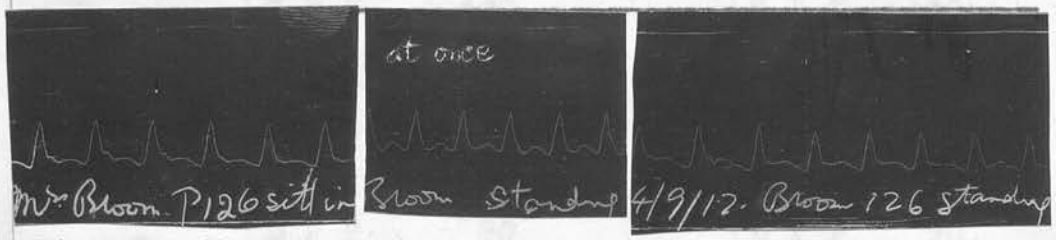


Fig. 48. Female age 29.

She was pale & anaemic & 6 weeks after her confinement. P.sitting 130: standing 130 & also 126 sitting: 126 standing as in Sphygmograph. Note that immediately on standing the blood pressure falls very low, but gradually improves after a short time.

49

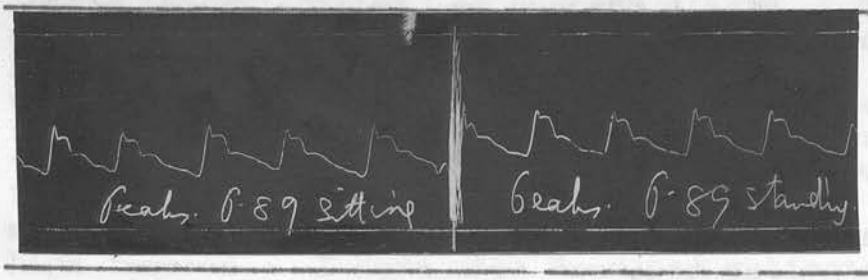
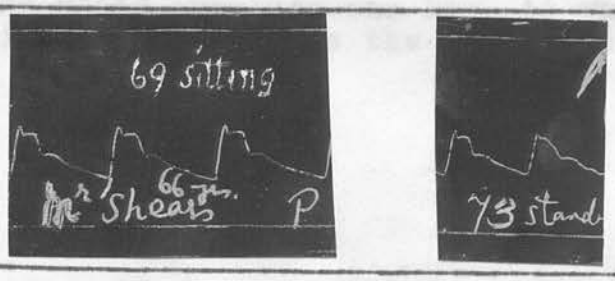


Fig. 49. Female age 69. Cardiac Debility.

50



POSTURE

Fig. 50. Female age 66. Bronchitis & slight Cardi--ac oedema.

Also the following cases:-

Male age 47 : Pulmonary Tuberculosis.

P.sitting	98	P.stand	97
S P P	140	S P P	145
D P P	90	D P P	90.

Female age 65 : Debility.

P. sitting	93	P.stand	98
S P P	140	S P P	130
D P P	90	D P P	95.

Female age 34. Anaemia: Tonsillitis.

P.sitting	106	P.stand	106
S P P	135	S P P	145
D P P	90	D P P	90.

& again:

P sitting	120	P.stand	126
S P P	150	S P P	145
D P P	90	D P P	90.

& also sitting: 103 standing 106.

I have mentioned before that though "Hypertension" is generally associated with "stability" of the Pulse, stability of the Pulse does not necessarily prove "Hypertension" as Huchard claims. The above cases are examples of stability and are not cases of Hypertension. Most of my observations have been made on the pulse in the sitting and erect posture, but as a rule there is a far greater difference in the pulse between the sitting and erect postures than between the recumbent and sitting postures. Fig. 40 shows stability in all postures without having high tension. I have also examined patients with failing Hearts and in their case there was no difference between sitting standing & lying; but though the Blood pressure was low, it was probably relatively high and as high as the Heart could endure.

POSTURE

THE FOLLOWING CASES ARE SOMEWHAT IRREGULAR.

51.

Fig. 51.
Female age 45. She was "run down" 3 weeks after her confinement. P.110 sitting 110 standing. Four days later the Sphygmogram was taken and the pulse rate was 103 sitting 107 standing and a few minutes afterwards the Pulse Pressure was taken.

P.sitting	98	P.stand	108
S P P	135	S P P	145
D P P	90	D P P	95.

Though the S.P.P. is greater on standing still on examination of the tracing it will be found that the Systolic Pressure is not so well sustained.

52

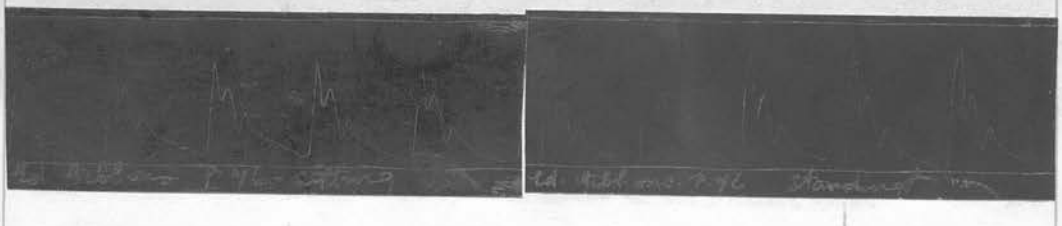


Fig. 52. Male age 62.

P.sitting	76	P.stand.	76
S P P	175	S P P	160
D P P	100	D P P	100.

This patient is like some other old and debilitated patients who have a fall of pressure on standing without increase in pulse rate. Note the more sudden Systole on standing.

POSTURE.

53

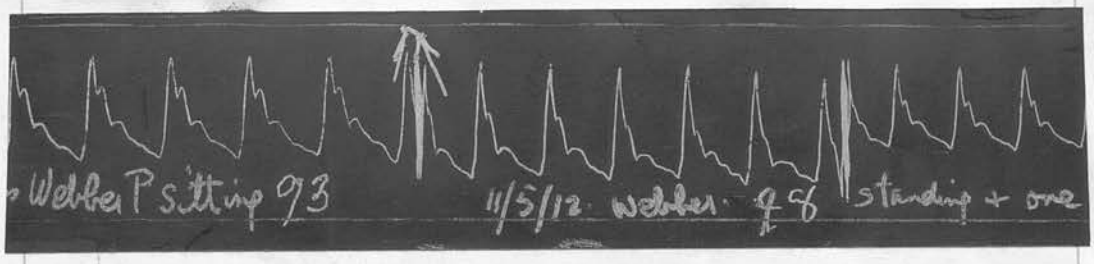


Fig. 53. Female age 65. General & Cardiac Debility: with Mitral Systolic murmur.

P.sitting	93	P.stand.	98
S P P	140	S P P	130
D P P	90	D P P	95.

Note the fall of pressure on standing without great increase in pulse rate. It will also be observed that the pressure as shown in the tracing falls immediately on standing, but improves later on. This immediate fall of pressure accounts for the "fainty" feelings some patients have on standing up suddenly, and it has also brought to a fatal issue some cases of Acrtic Incompetence.

54

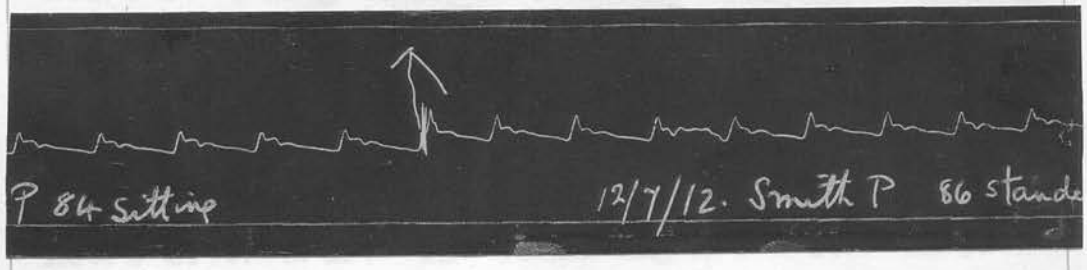
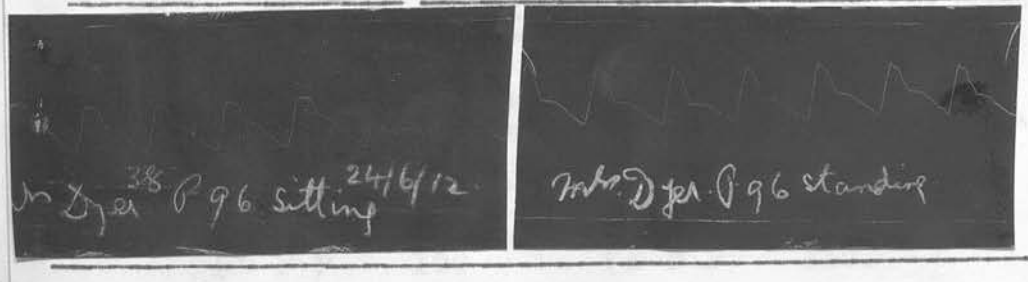


Fig. 54. Male age 53. Asthma & Bronchitis.

P.sitting	84	P.stand-	86
S P P	150	S P P	140
D P P	110	D P P	105.

The patient has also a fall of blood pressure (S P P) and no great increase of rate on standing.

55



POSTURE.

57

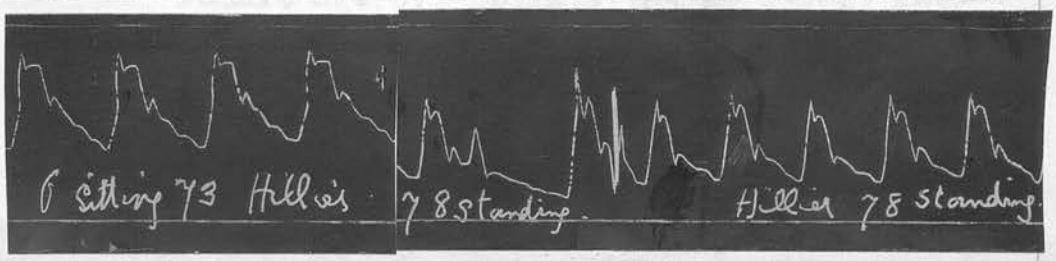


Fig. 57.

Male age 86. Bronchitis : Cardiac Dilatation & oedema of ankles.

P.sitting 73	P.stand.78
S P P 180	S P P 180.

Though the Systolic Pressure is the same in both cases the pressure is not sustained on standing and is an example of what Broadbent (9) would call " Virtual tension."

58

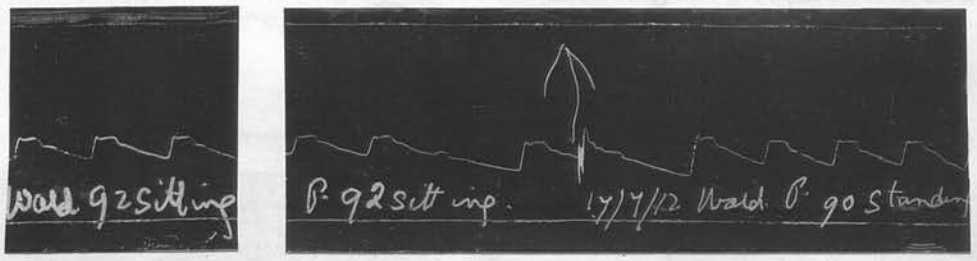
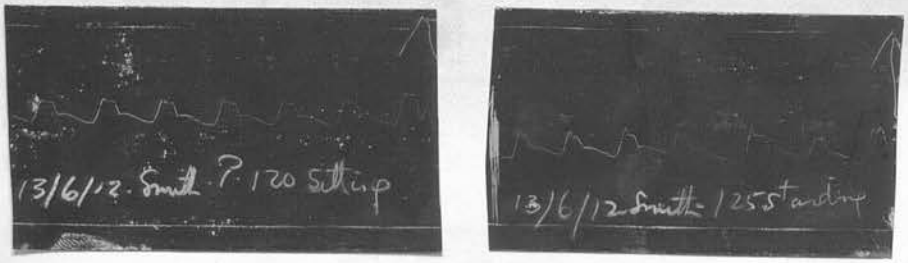


Fig. 58.

Female age 72. Dilatation of Heart with Dyspnoea : slight oedema of legs : no murmur. Posture had very slight effect on the pulse. There were a good number of extra systoles and one is shown in each position.

59



POSTURE.

Fig. 59.

Female age 67. Dilatation of Heart: apex 4¼ inches from mid line : mitral systolic murmur: Bronchitis. A good number of extra systoles though none are shown on the trace. On standing the pulse develops a slight tendency to the "Pulsus alternans." (This is more marked in a later tracing farther on.)

60.

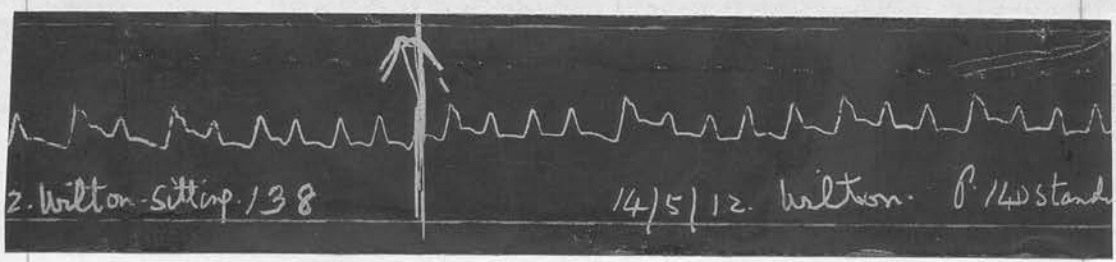
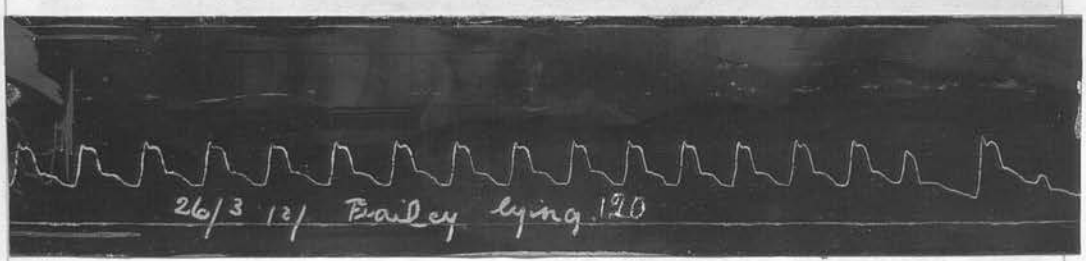
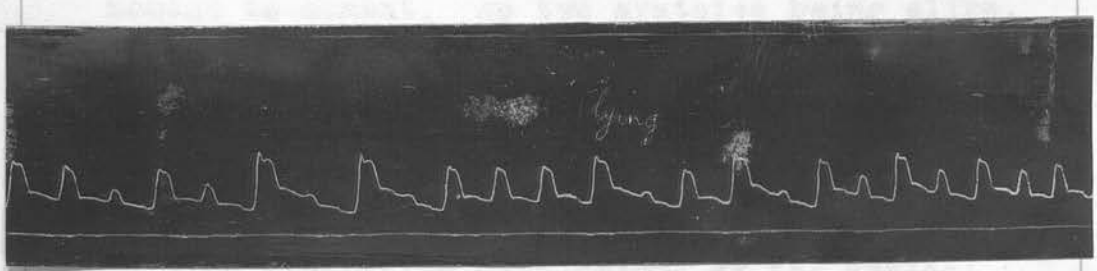


Fig. 60.

Female age 63. She walked into the Dispensary and was suffering from Bronchitis: Cardiac Dilatation: apex 4 inches from mid line: oedema of ankles and mitral systolic murmur. Strong Cardiac pulsation, with every 3rd beat stronger still. Note the grossly irregular pulse which shows no change on standing.

61.





POSTURE

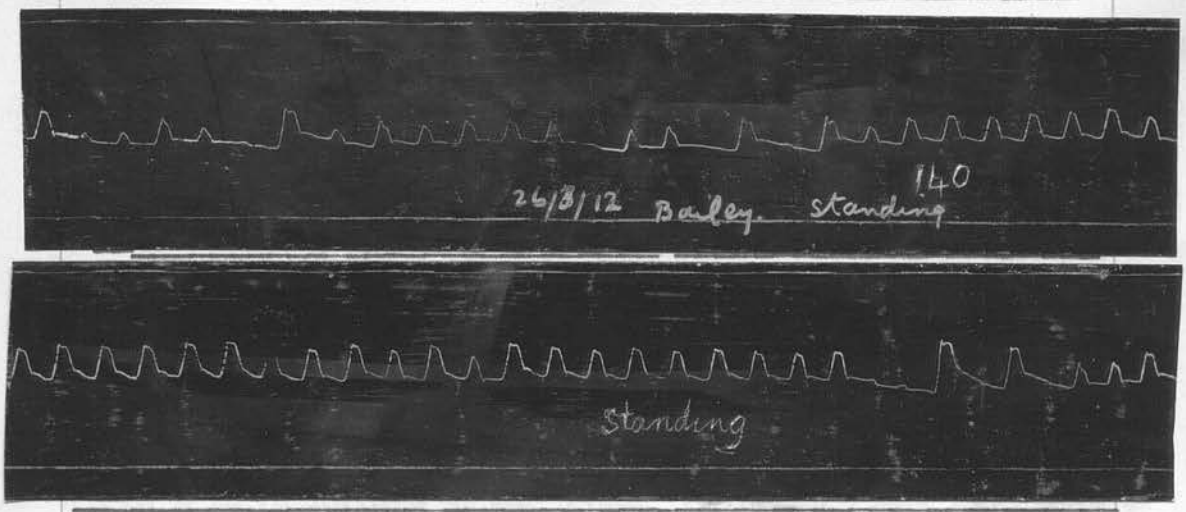
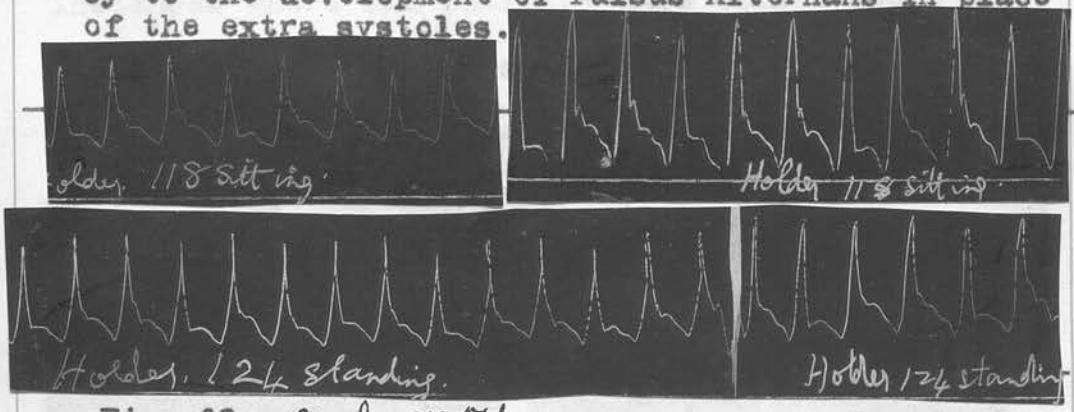


Fig. 61.

Female, age 80 : Cardiac Dilatation: apex 4 inches from mid line : mitral systolic murmur. P. 120 lying : 140 standing. On standing the pressure falls markedly and there is also a tendency to the development of Pulsus Alternans in place of the extra systoles.



62.

Fig. 62. Male, age 71.

Note the variations in pulse pressure from moment to moment, no two systoles being alike.

P. sitting	118	P. stand.	124
S P P	150	S P P	150
D P P	100	D P P	100.

This patient was suffering from very evident Cardiac dilatation with oedema of the ankles: marked cyanosis & Bronchitic Râles all over his chest. He was not in bed and was climbing up 13 steps to his Bedroom. His temperature was not raised on any occasion on which I examined him and

POSTURE.

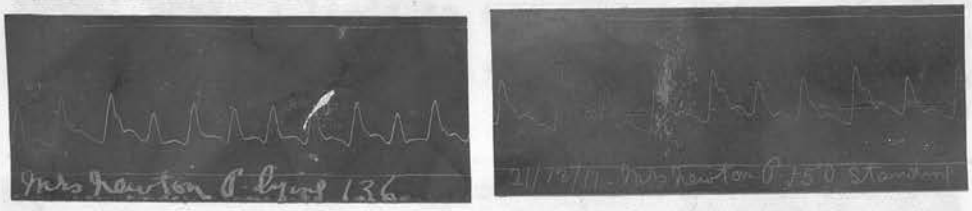
Fig. 62. contd.

he had a generalised cold sweat and cold feet. Notwithstanding, I suspected that he was suffering from Lobar Pneumonia of the aged and in a day or so he was bringing up some chocolate-coloured spit. I have seen many cases of Lobar Pneumonia in the aged in a large Workhouse Hospital, and in many cases the temperature didn't rise above 99° F. This man felt bad 4 days before I was sent for and in the aged the Pneumonia is often ingravescent and the patient has malaise, for days before the known onset.

Hourmann & Dechambre & Durand Fardel give instances where old patients have walked about and have dropped down dead suffering from this Pneumonia. Babcock gives a good description of Lobar Pneumonia in the aged.

(63)

(a)



(b)

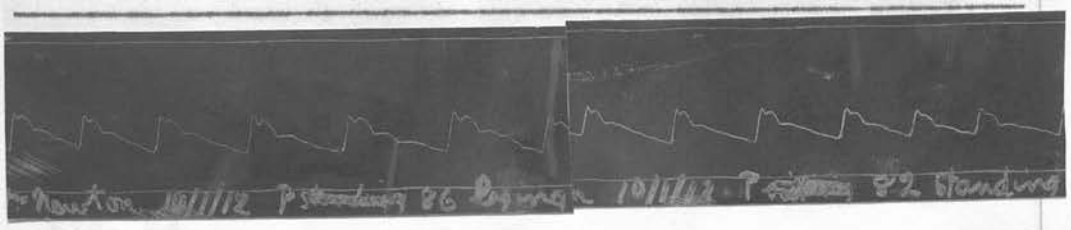


Fig. 63.

Female age 76. Cardiac anasarca: Systolic mitral murmur : dilated Heart with apex 4½ inches from the mid line.

(P.lying 136 (P.standing 150
(S.P.P 200 (S.P.P. 200.

POSTURE.

Fig. 63. contd.

and 3 weeks later after getting ~~m~~ X of the Tincture of Strophanthus, three times a day:--

P. lying 86	P. standing 82
S P P 200	S P P 200.

There was not much difference in the Systolic Pressure after treatment, but though the Systolic Pressure on the first occasion was as high as on the second; tracing 63 (a) shows that the tension was not so well sustained as in tracing 63 (b). 63 (a) shows well the irritability of weakness.

Janeway (10) Thorne (11) & Price (12) state that in many instances Digitalis does not increase the Systolic pressure: but in such cases, as in the above case the systole of the Ventricle is better maintained. Similarly in the debilitated the Horizontal posture leads to a more complete cardiac systole though the Systolic Pressure may be reduced.

64

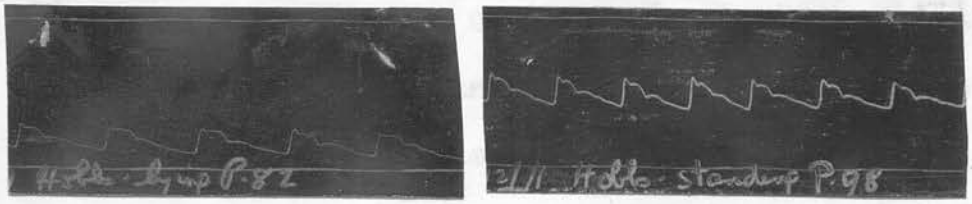


Fig. 64.

Male age 71. Bronchitis & slight Cardiac Dilatation.

P.lying 82	P.standing 98
S P P 145	S P P 155
D P P 90	D P P 100.

POSTURE.

Fig. 64. contd.

In this case the pressure is lower in the recumbent posture but the Systole of the Ventricle is more full and complete and that is the main object of rest in bed in Cardiac cases.

PULSES THAT UNDERGO A CHANGE OF 10 OR MORE THAN 10 BEATS PER MINUTE IN CHANGING FROM SITTING TO STANDING.

It is generally understood that such cases are the subjects of Hypotension but that need not be so, as a pulse with a Systolic Pressure of 150 may undergo considerable postural variation. It all depends on the stability of the pulse and the absence of variations in pressure.

When a person suddenly stands up after sitting, there is a tendency to a fall of pressure which is usually speedily counterbalanced by the activity of the Vaso-motor centre. If however the tone of the Vaso-motor centre is poor and the patient is the subject of Splanchnic Stasis, the blood is apt to accumulate in the splanchnic vessels at the expense of the systemic vessels and there is a constant fall of pressure and a marked increase in the pulse rate.

Osler (13) quotes the old experiment of holding up a hutch rabbit by the ears, till so much blood accumulates in the splanchnic reservoir, that the pressure falls in the smaller arteries of other regions and the animal dies. Leonard Hill (14. 15. 16.)

has done a considerable amount of work on this subject and says that the pressure in a normal healthy individual is maximal in the Vertical and minimal in the horizontal position, but that in conditions of Asthenia the opposite obtains. Oliver (17. 18. 19) holds similar views but seems to look upon a fall of pressure on standing as very exceptional. Erlanger & Hooker (20) show that the minimal pressure usually rises considerably and the maximal pressure always decreases upon standing up after having lain down. The pulse rate also increases accordingly. They also found that when normal men were supported in the vertical posture the Blood pressure fell, maximal from 120 - 103 mms. and minimal from 92 . 5 to 86. Janeway(10) says "the weight of evidence seems to point to the recumbent posture as conducive to the lowest pressure, standing, and sitting being alike in raising both systolic and diastolic pressures 5 - 10 mms." He quotes Leonard Hill : Cook & Briggs, as describing a rise & Hensen a fall of pressure on standing. But I think that such definite statements can't be made as the pressure rises in some cases and falls in others on standing.

In pulses that show a great increase of rate on standing I have found that the Systolic Pressure falls and the Diastolic pressure rises. I have felt quite satisfied with regard to the fall of systolic pressure but have not been so satisfied with the ~~fall~~ rise of Diastolic Pressure. I have estimated the diastolic

POSTURE.

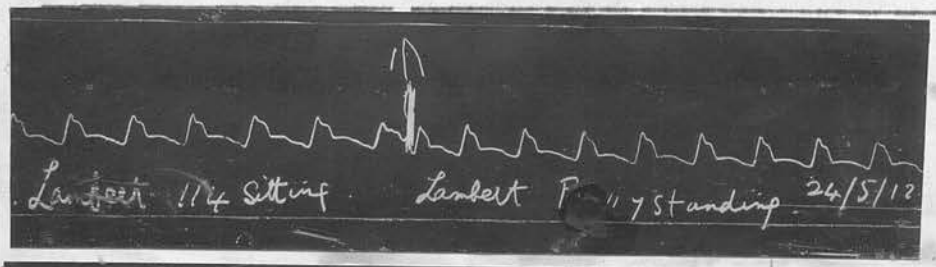
pressure by the Auscultatory method used in Oliver's Sphygmometer and have usually found that when the Systolic pressure falls on standing, the pulse is weaker and does not give such a full and distinct auscultatory throb as the stronger pulse found in the sitting posture. Considering that the auscultatory throb is less pronounced, it need not be surprising that this weaker throb is lost at an earlier stage in the release pressure than the stronger one. This results in a higher reading of the Diastolic Pressure. With this method I have invariably found that a pulse with a large excursion wave has a well-marked auscultatory throb and a low Diastolic pressure, while a small pulse with a small wave & throb has a high Diastolic Pressure. In a case of Aortic Incompetence I was able to hear well marked auscultatory throbbings after the nercury had passed the Zero mark in the tube. Dr.Gibson (21.) comments on the difficulty of estimating the lower limit of maximal oscillation in cases of Aortic Incompetence. In many cases the Sphygmograph showed a distinct fall of diastolic pressure on standing where the Sphygmometer showed an increased diastolic pressure.

However, I give my results as I found them & a lowered Systolic Pressure & raised diastolic pressure will be found associated with an increased pulse rate.

The following Sphygmograms show the change effected by posture and they tally with those

POSTURE.

(b.)



(c).

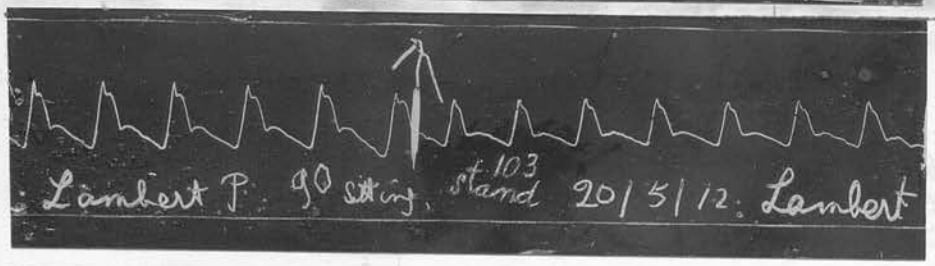


Fig. 67.
Patient has just got up out of bed after a 3 week's stay there, for Subacute Rheumatism.

67 (a) Note the less sustained systole on standing, but it will be seen that after 1 minute the pulse has become slower & the pressure better maintained.

P.sitting 83	P.standing 93
S P P 130	S P P 120
D P P 75	D P P 75.

also (72 sitting : 82 standing.
(114 sitting : 117 standing.
(90 sitting : 103 standing.

68

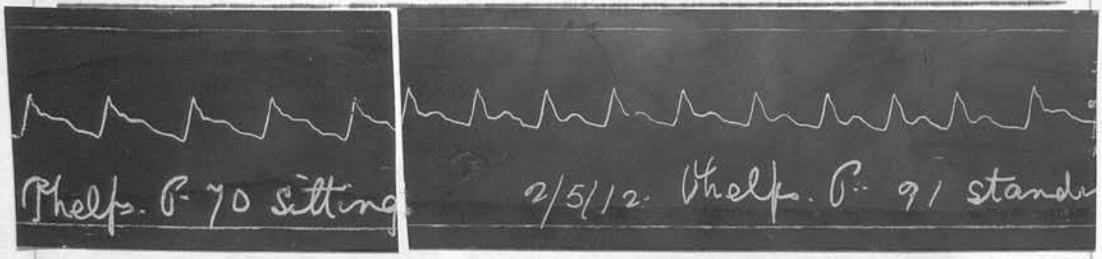


Fig.68. Female 28. Gastritis.

P sitting 76	P.stand 94
S P P 140	S P P 130
D P P 90	D P P 100.

Note the fall of pressure on standing.

POSTURE.

69

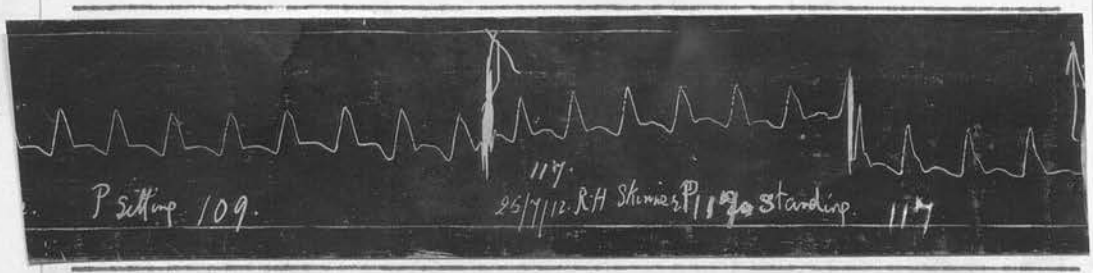


Fig. 69.

Male age 38. Has been suffering for 4 weeks with a very septic Throat.

P.sitting	109	P.stand	117	P.lying	94
S P P	140	S P P	135	S P P	125
D P P	90	D P P	105	D P P	90.

immediately on standing the S.P.P. rose to 145 but in a short time it fell to 135.

70.

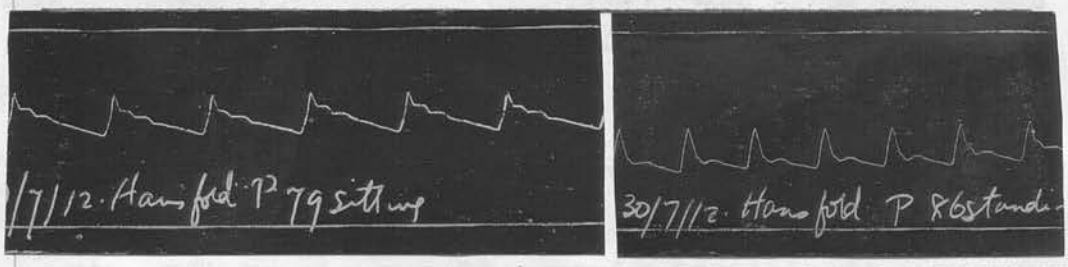


Fig. 70. Male age 38 : Neurotic.

P.sitting	79	P.stand	86	P.lying	81
S.P.P	155	S P P	160	S P P	160
D P P	95	D P P	95	D P P	190.

The pulse was more ample & stronger on lying and though the S.P.P.is high on standing it is not sustained.

71.

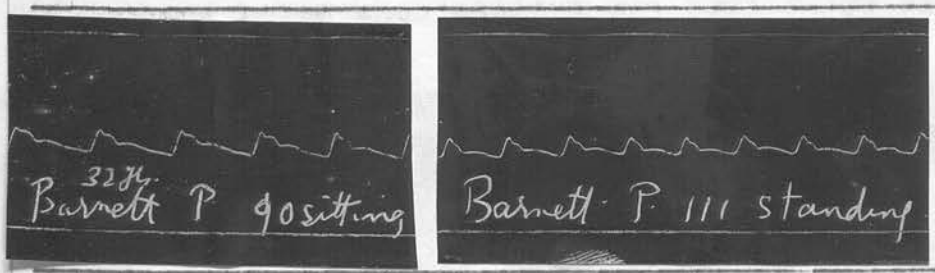


Fig. 71. Female age 32 : Asthma.

P.sitting	95	P.stand.	118
S P P	115	S P P	105

also (90 sitting : 111 stand.
100 sitting 110 Stand.

POSTURE.

Fig. 71. contd.

Pulse much weaker on standing.

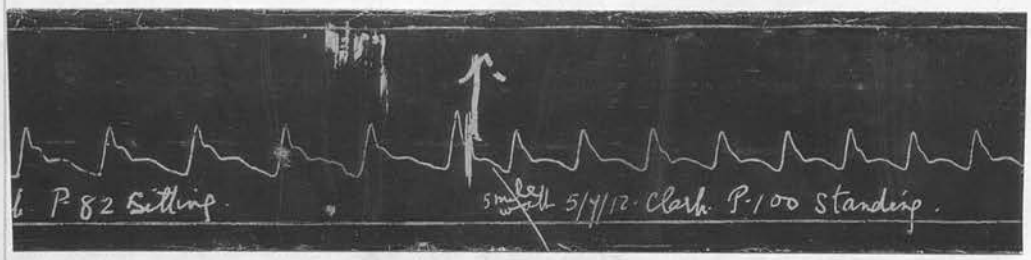
72. 

Fig. 72. Clark age 29.

P.sitting	82	P.stand	100
S P P	130	S P P	120
D P P	100	D P P	100

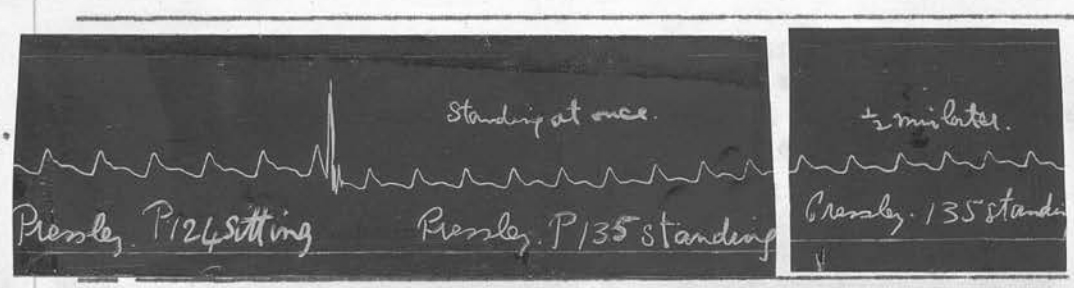
73. 

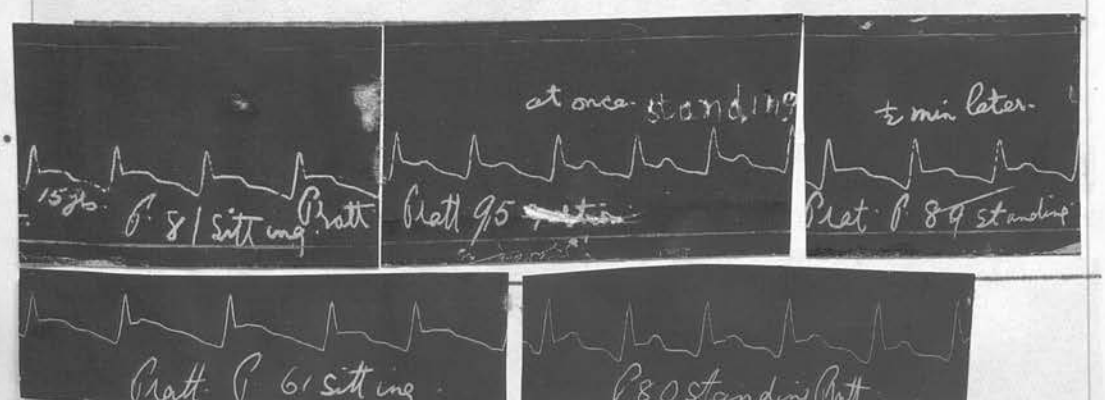
Fig. 73. Female age 28 : acute tonsillitis.

Note the immediate fall of pressure on standing, but the gradual return of pressure after ½ minute.

P.sitting	124	P.stand	135
S P P	130	S P P	130
D P P	115	D P P	110.

also sitting 125 : standing 145.

and 2 weeks later when patient was better 89 sitting 89 standing.

74. 

POSTURE

Fig. 74.

Male age 15.

P.sitting	81	P.stand.	89
S P P	100	S P P	90
D P P	70	D P P	80.

75

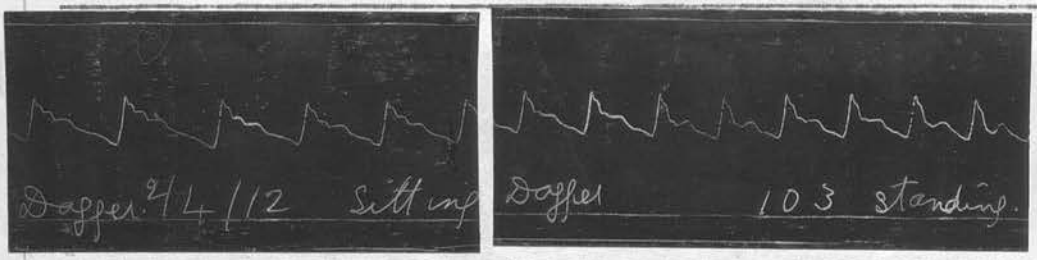


Fig. 75. Female age 25.

P.sitting	80	P.stand.	103
S P P	140	S P P	150
D P P	100	D P P	110.

On standing the S.P.P. is greater than sitting, but on examining the Sphygmogram it will be noticed that there is a fall of pressure and if the pressure is greater it is not so well sustained.

76

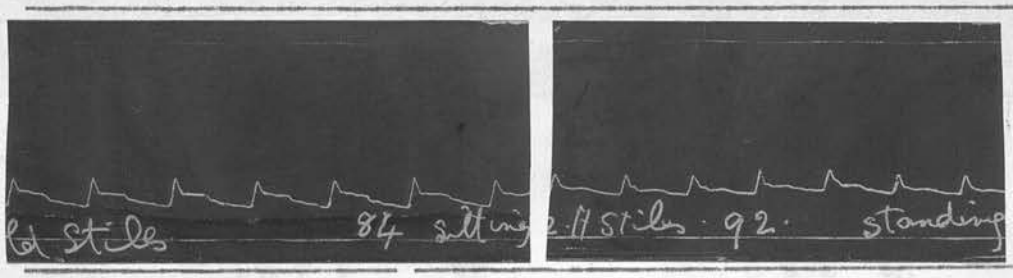


Fig. 76. Male age 10. Influenza.

77.

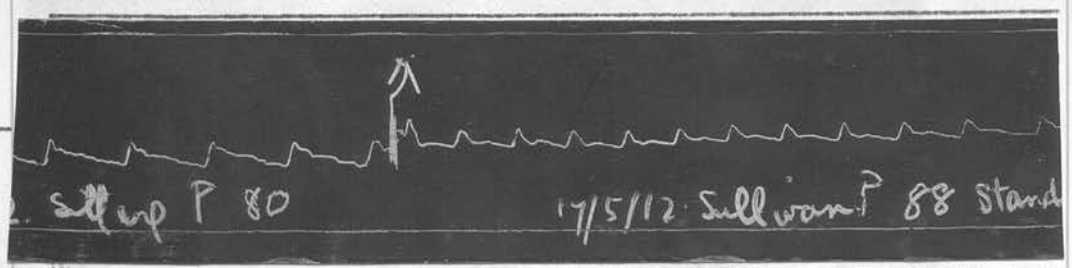
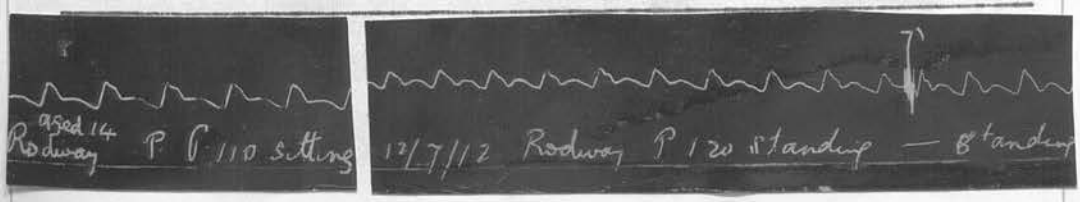


Fig. 77.

Male age 29. Mitral systolic murmur and apex 1 finger-breadth beyond the nipple.

78



POSTURE.

Fig. 78. Female age 14. Mitral Systolic murmur, but the Cardiac Apex is not beyond the nipple line.

79

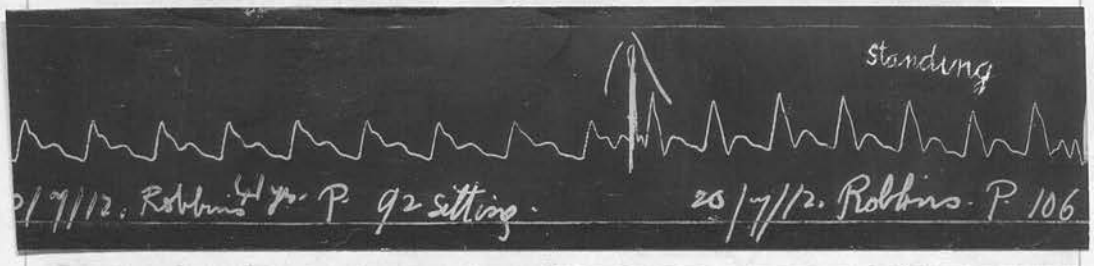


Fig. 79 Male age 41. Pulmonary Tuberculosis. Note the great fall of pressure on standing.

80.

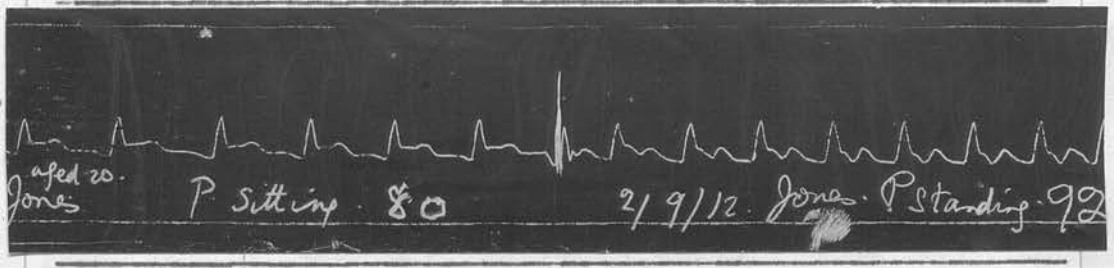


Fig. 80. Male age 20

P. sitting	80	P. Stand.	92
S P P	125	S P P	120.
D P P	75	D P P	90.

81.

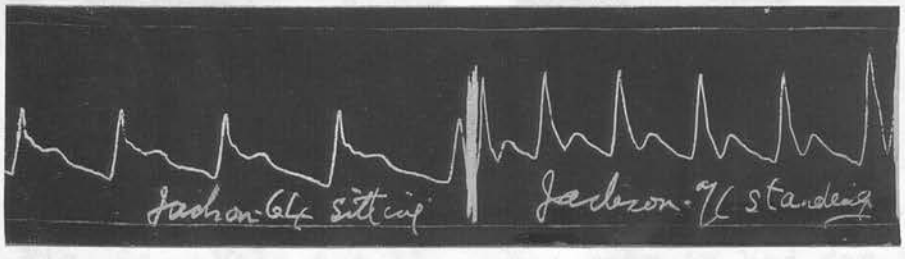
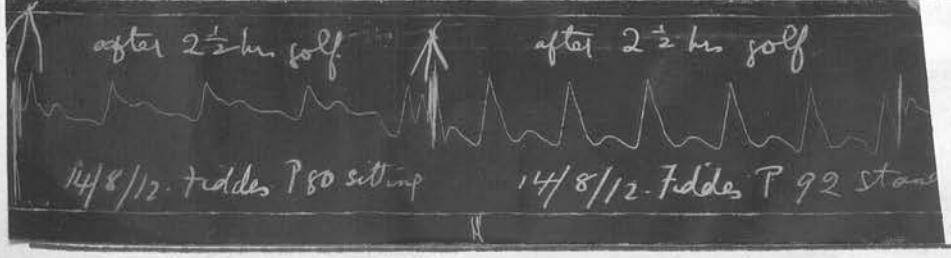


Fig. 81. Male age 17.

Pstt.	64	P stand	95
S B P	130	S B P	120
D B P	70	D B P	80.

82.
(a)



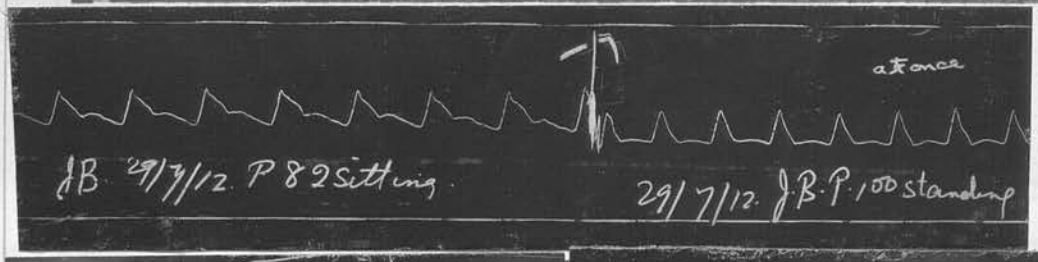
POSTURE

82 (b)

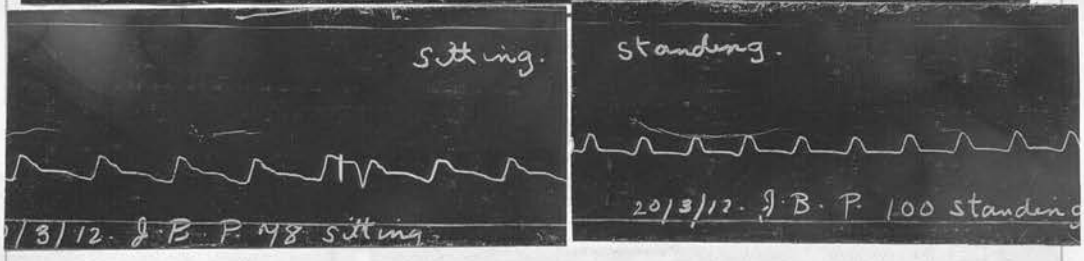
Fig. 82 Male age 31.

Note the great fall of pressure on standing.

83 (a)



(b)



"Fig. 83. Male age 29. Note fall of pressure on standing.

84.

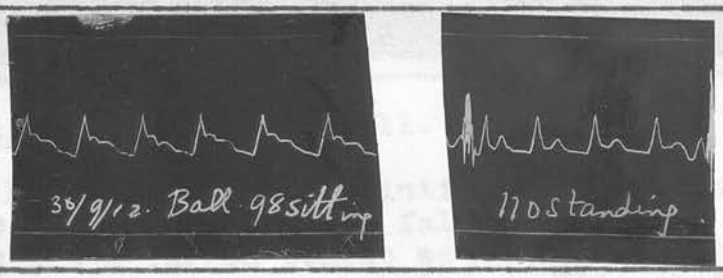
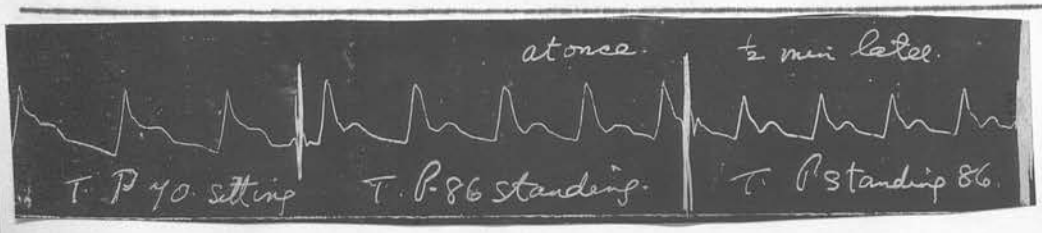


Fig. 84. Male age 17. has been in bed for 3 days with a septic mouth.
(P 98 sitting & 110 standing.
(P.93 sitting & 107 standing.

85.



POSTURE

Fig. 85. Male age 29.

P.sitting 70	P.standing 86.
S P P 150	S P P 140
D P P 70	D P P 75.

The next 2 tracings were taken from boys of 11 years. As a rule boys of that age show very little postural variation, but both were very debilitated.

86

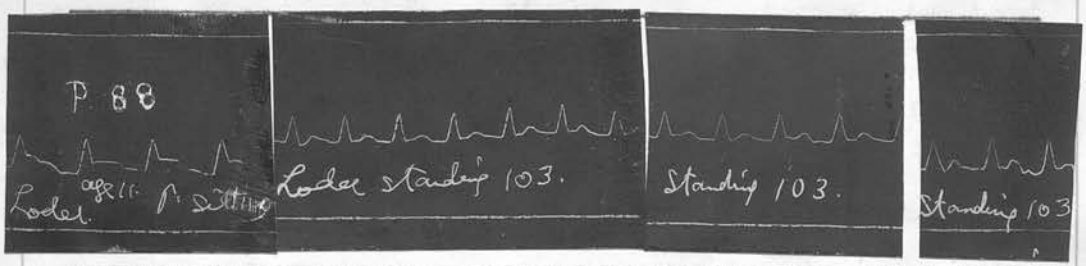


Fig. 86. Boy age 11. Has been confined to bed for 18 days with Pleurisy with effusion and the tracing was taken while he sat on the edge of the bed. The pressure falls markedly on standing.
Also on another occasion.
Sitting 99 Standing 110.

87

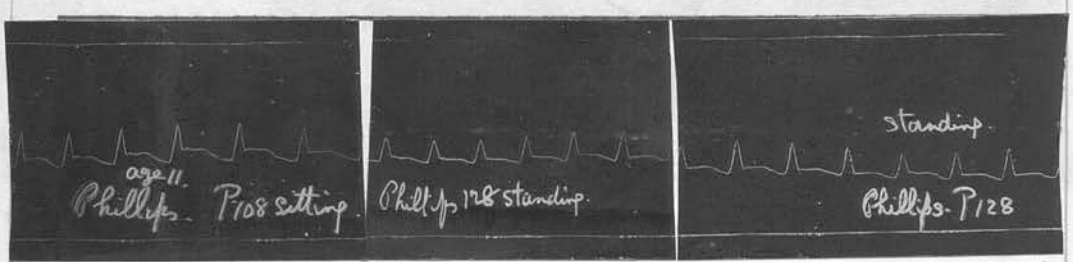


Fig. 87. Male age 11.

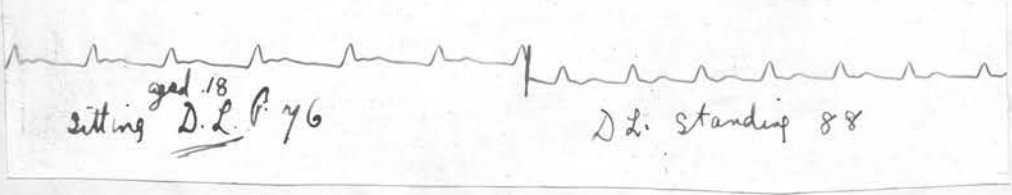
He is subject to fainting attacks especially if he stands much. Note fall of pressure on standing. He had a furred tongue so that probably in his case, Gastric irritation has led to Splanchnic congestion. Children under 16 as a rule show little postural variation but in cases of Gastritis you usually find a great increase of pulse rate on standing. e.g. girl age 8 Sickness & Diarrhoea
P.sitting 134 standing 150.

The following tracings were taken from

School-boys of about the age of 17. -

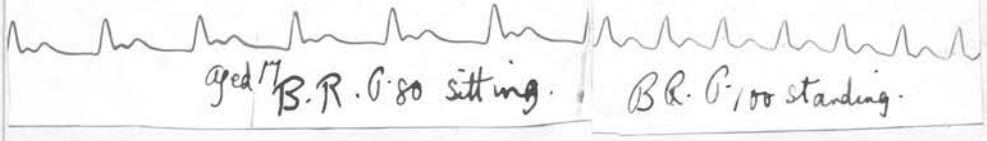
POSTURE.

88

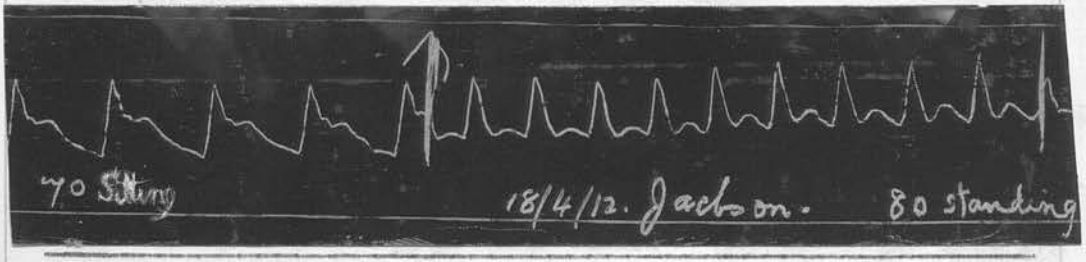


89

90.



91.



Figs. 90 & 91 are taken from boys of 17 and they both belonged to their School Cadet Corps which sent detachments up to London to line the Streets at the Coronation celebrations of 1911. The boys were allowed permission to lie down from time to time if they felt faint and a considerable number availed themselves of this opportunity. It will be seen that they have a fall of pressure & increase of pulse rate on standing and we can understand their tendency to faint if we consider that their Systolic Pressure would fall still farther and their pulse rate increase

still more as exhaustion tired out their vaso motor mechanism. Splanchnic stasis & collapse however would speedily be neutralised by the recumbent posture. Lauder Brunton & Tunnicliffe (23) found that after standing 3 hours in one position a man's blood pressure had only fallen 5 mm and they say that this indicates the slight extent to which the circulation in man is affected by the fatigue of standing for 3 hours. Though that was true in that particular case I'm afraid that other cases might show a much more severe reaction. Allbutt (24) instances "Church faints" and faints in over-heated rooms as conditions, due not to Cardiac failure but to an expansion of cutaneous & Splanchnic vessels with a sharp fall of arterial pressure & says "in such hypersensitive persons the pulse varies too widely on quickly rising, sitting, or lying down." He mentions the case of an undergraduate who induced exhaustion through cycling and who became quite collapsed and pulseless when his head and shoulders were raised from the pillow.

Oliver : Hirschfelder : Allbutt : Oliphant Nicholson & most authors consider that debility & exhaustion tend to an exaggeration of the normal postural variation and though Cardiac disease often tends to stability of the circulation, Barber (25) & Michell (26) state that in heart strain the postural increase of rate is very great & the patients are liable to faint.

Clement Dukes (27) found that many strong

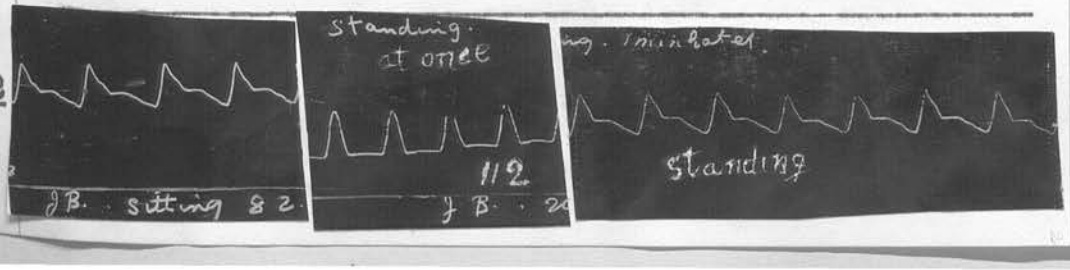
POSTURE.

healthy boys at Rugby School fainted when standing for 15 minutes at morning prayers before breakfast. He thought it was due to the circulation proving unfit for the strain of the sudden alteration from Recumbency to the erect posture and in most of these cases he found "Functional Albuminuria" He makes no remark as to the postural variations of the pulse.

Broadbent (9) says of Functional Albuminuria "The circulation in such cases is very unstable;the Left Heart has a feeble impulse, but the Right Ventricle a strong beat" and Edel (28) found in such cases a fall of pressure on rising from bed.

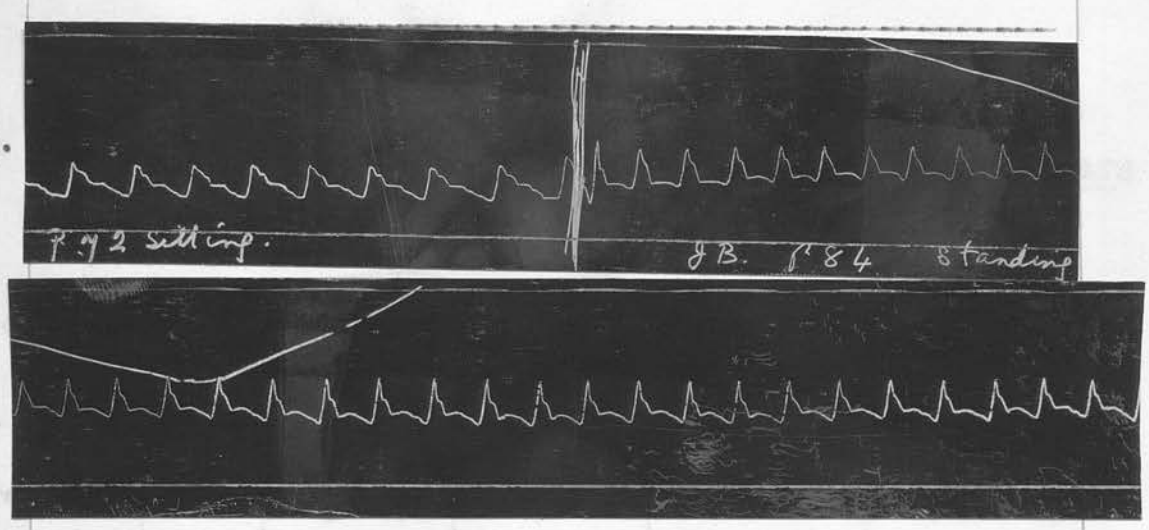
The postural increase of rate and the fall of pressure is most marked immediately after standing and in many of the Sphygmograms I have shown, it may be seen that after ½ minute the arterial tone begins to improve. In estimating the rate I have usually taken the pulse about ½ - 1 minute after the change of posture. Even in high tension pulses which show neither increase of rate nor fall of pressure it may be noted that there is a transitory reduction in pressure.

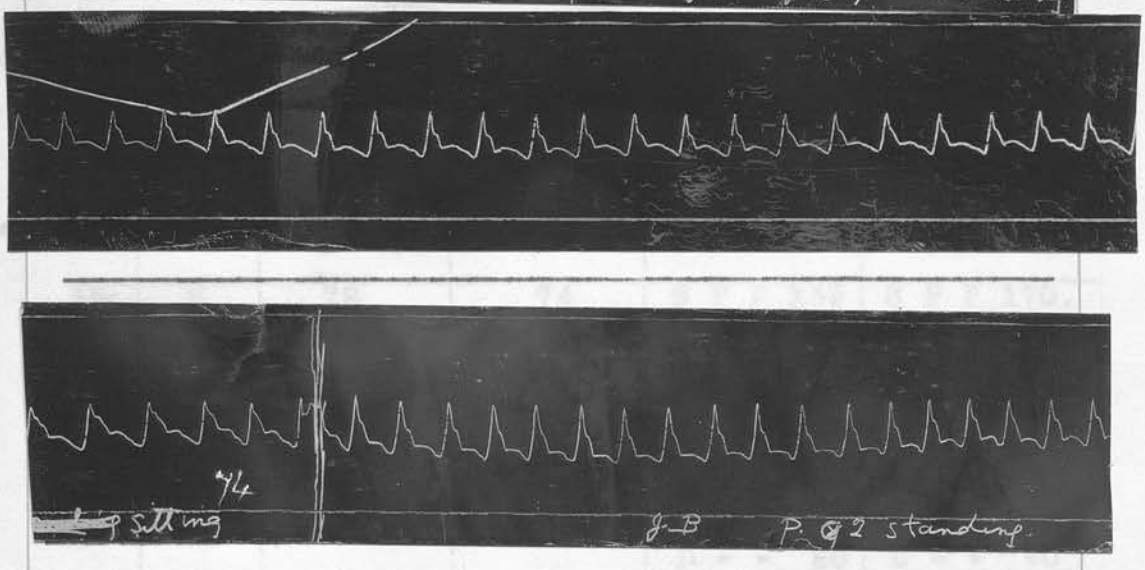
The following cases show the fall of tension immediately on standing and the gradual return to a higher pressure. Graves (4) said that after 15 minutes the postural increase of rate disappears.-



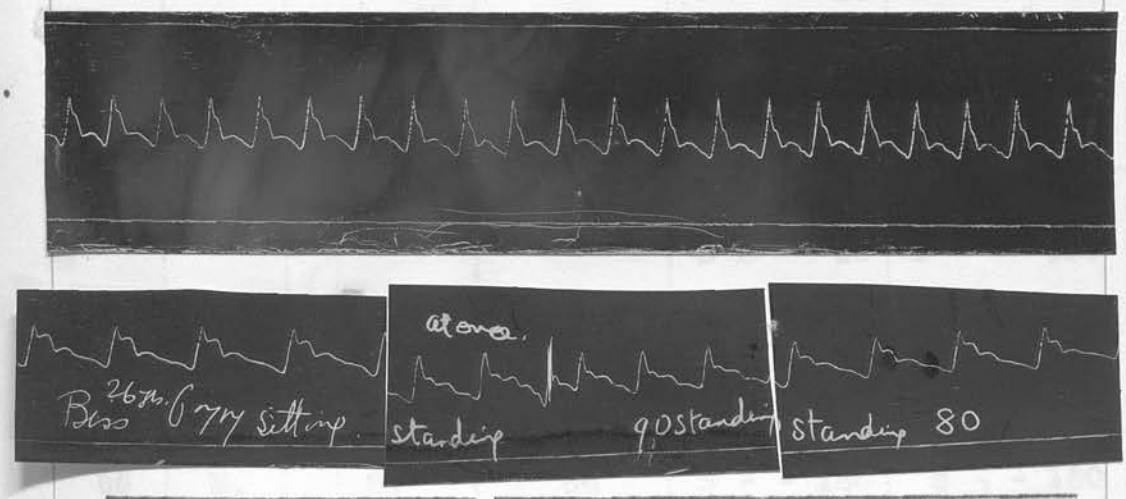
POSTURE.

93.





94.



Figs. 93 & 94. are continuous tracings & show the gradual improvement in arterial tone.

Appended are some statistics relating to the effect on the Pulse rate on changing from the sitting to the erect posture.

We will deal with

(1) No Postural Variation or not more than 5 beats per minute.

POSTURE

Statistics:-

(1) NO POSTURAL VARIATION OR NOT MORE THAN 5 BEATS PER MINUTE.

Age	Sex	Pulse Rate Sitting	Pulse Rate Standing	Pulse Pressure. Sitting	Pulse Pressure. Standing.
80	M	80	80	S P P 160 D P P 120	S P P 160 D P P 130
65	M	72	74	S P P 165	S P P 170.
66	M	76	80	S - - 110 D - - 85	S - - 115 D - - 75
60	M	90	92	S - - 150 D - - 80	S - - 145 D - - 90
72	M	48	48	S - - 145 D - - 65	S - - 145 D - - 65
65	M	86	86	S - - 135 D - - 80	S - - 150 D - - 95.
68	M	66	66	S - - 220 D - - 130	S - - 210 D - - 130.
85	M.	86	86	S - - 180	S - - 180
52	M.	78	78	S - - 115 D - - 65	S - - 120 D - - 70
50	F	84	84	S - - 125 D - - 70	S - - 130 D - - 70
44	M	84	84	S - - 125 D - - 80	S - - 135 D - - 80

POSTURE.

Statistics contd.

Age	Sex	Pulse rate Sitting	Pulse rate Standing	Pulse Pressure Sitting	Pulse Pressure Standing
69	M	77	78	S P P 160 D P P 80	S P P 160 D P P 90
81	M	84	84	S - - 160	S - - 165
68	M	84	84	S- - 210 D - - 130	S - - 210 D - - 135
62	F	76	77	S - - 170 D - - 110	S - - 180 D - - 110
80	F	102	102	S - - 170 D - - 90	S - - 180 D - - 110
75	M	64	66	S - - 180 D - - 100	S - - 180 D - - 110
69	F	76	76	S - - 180	S - - 180
69	F	77	78	S - - 140 D - - 85	S - - 140 D - - 85
74	M	65	66	S p p 190 D - - 80	S p p 190 D - - 75
75	F	90	90	S - - 200 D - - 100	S - - 200 D - - 110
65	M	92	89	S - - 190 D - - 105	S - - 190 D - - 110
36	M	76	77	S - - 145 D - - 100	S - - 145 D - - 95
50	M	89	90	S - - 170 D - - 120	S - - 180 D - - 120

POSTURE.

Statistics contd.

Age	Sex	Pulse Rate Sitting	Pulse Rate Standing	Pulse Pressure. Sitting	Pulse Pressure. Standing.
14	M	88	86	S p p 100 D - - 75	S P P 105 D - - 75
46	M.	111	114	S - - 120 D - - 95	S - - 120 D - - 100
33	M	101	103	S - - 145 D - - 80	S - - 145 D - - 100
47	M	98	97	S - - 140 D - - 90	S p p 145 D - - 90
17	M	106	106	S - - 135 D - - 75	S - - 140 D - - 80
14	M	88	91	S p p 135 D - - 100	S - - 135 D - - 100
55	M	68	70	S - - 140 D - - 90	S - - 150 D - - 100
75	M	78	81	S - - 190 D - - 120	S - - 190 D - - 130
51	F	74	78	S - - 160 D - - 80	S - - 170 D - - 80
59	F	98	102	S - - 160 D - - 110	S - - 160 D - - 110
45	M	73	78	S - - 150 D p p 70	S - - 150 D - - 75
65	M	69	74	S - - 125 D - - 70	S - - 125 D - - 90
33	M	115	120	S - - 110 D - - 75	S - - 110 D - - 80

POSTURE

Statistics contd.

Age	Sex	Pulse Rate Sitting	Pulse Rate Standing	Pulse Pressure Sitting	Pulse Pressure Standing.
79	M	65	70	S - - 150 D p p 75	S p p 150 D - - 75
86	M	73	78	S - - 180	S - -180
38	M	82	86	S p p 130	S p p 140
59	F	100	101	S - - 120 D - - 75	S - - 120 D - - 80
42	M	78	83	S - - 140 D - - 70	S - - 130 D - - 65
50	M	89	90	S - - 170 D - - 120	S - - 180 D - - 120
78	M	96	96	S - - 110 D - - 75	S - - 115 D - - 75
75	M	76	74	S - - 190 D - - 105	S - - 190 D - - 110
38	F	96	96	S - - 130 D - - 65	S - - 125 D - - 70
43	M	84	86	S - - 150 D - - 110	S - - 140 D - - 105

In the above cases there is generally an increase of Systolic Pressure on standing and rarely a fall.

THOSE THAT SHOW AN INCREASE OF RATE ON STANDING OF 10 OR MORE BEATS PER MINUTE.

Age	Sex	Pulse Rate Sitting	Pulse Rate Standing	Pulse Pressure Sitting	Pulse Pressure Standing
56	M	88	106	S - - 135 D - - 80	S p p 130 D - - 90
80	M	86	96	S - - 170 D - - 110	S - - 160 D - - 125

POSTURE

Statistics contd.

Age	Sex	Pulse Rate		Pulse Pressure	
		Sitting	Standing	Sitting	Standing
18	M	76	87	S - - 105 D - - 75	S - - 100 D - - 85
68	M	60	72	S p p 150 D - - 85	S - - 140 D - - 90
83	M	56	66	S - - 160 D - - 80	S - - 150 D - - 85
76	M	82	92	S - - 125 D - - 80	S - - 115 D - - 90
62	M	74	84	S - - 175 D - - 110	S - - 170 D - - 115
72	M	108	120	S - - 120 D - - 90	S - - 115 D - - 90
55	M	90	100	S - - 130	S - - 115
72	M	72	86	S - - 160 D - - 80	S - - 145 D - - 100
81	F	89	107	S p p 180 D - - 100	S - - 165 D - - 110
18	F	86	120	S - - 100	S - - 100
28	F	76	94	S - - 140 D - - 90	S - - 130 D - - 100
39	F	90	100	S - - 125 D - - 80	S - - 120 D - - 80
78	M	76	87	S - - 190 D - - 90	S - - 175 D - - 100
89	M	77	88	S - - 135 D - - 65	S - - 130 D - - 65
39	F	86	96	S - - 140 D - - 90	S - - 130 D - - 90
27	F	100	118	S - - 140 D - - 80	S - - 125 D - - 90
38	M	109	117	S p p 140 D - - 90	S - - 135 D - - 90
20	M	80	92	S - - 125 D - - 75	S - - 120 D - - 90

POSTURE.

Statistics contd.

Age	Sex	Pulse Rate Sitting	Pulse Rate Standing	Pulse Pressure Sitting	Pulse Pressure Standing
32	F	95	118	S - - 115	S - - 105
28	F	124	135	S - - 130 D - - 115	S - -130 D - -110

In the above cases there is usually a fall of Systolic Pressure on standing ..

THE FOLLOWING HAVE A CHANGE IN POSTURAL RATE OF MORE THEN 5 BEATS PER MINUTE BUT LESS THAN 10.

Age	Sex	Pulse Rate Sitting	Pulse Rate Standing	Pulse Pressure Sitting	Pulse Pressure Standing
64	M	94	100	S p p 130 D - - 105	S p p 115 D - - 95
30	M	92	100	S - - 180 D - - 60	S - - 200 D - - 85
75	M	82	90	S p p 160 D - - 95	S - - 170 D - - 105
43	M	72	80	S - - 150 D - - 90	S - - 150 D - - 95
39	M	90	96	S - - 130 D - - 110	S - - 130 D - - 120
56	M	100	108	S - - 170 D - - 130	S - - 170 D - - 140
38	M	79	86	S - - 155 D - - 95	S - - 160 D - - 95
23	F	78	86	S p p 125	S - - 115
15	M	81	89	S p p 100 D - - 70	S - - 90 D - - 80
46	M	74	80	S - - 160 D - - 90	S - - 145 D - - 105
31	M	79	86	S - - 130 D - - 95	S - - 135 D - - 110
70	m	75	81	S - - 170 D - - 100	S - - 180 D - - 110

POSTURE

In these long lists of cases it will be noted as a rule that when the Pulse rate increases on standing the Systolic Pressure falls; but when the Systolic Pressure rises or remains about the same on standing there is as a rule a slight or no postural variation.

I stated before that it was hardly fair to make definite statements in connection with this subject unless the age were also stated, for it will be found that there is a greater stability of the Pulse in patients who are over 50 years.

In 49 Patients over 50 years, I found:--

15, with no postural variation or with a reduction on standing.
18, with not more than 5 beats postural variation.
4, with more than 5 and less than 10 beats.
12, with 10 or more beats per minute increase.

The average increased rate on standing after sitting of 49 patients of 50 years and over was 4 beats per minute; and when we take into consideration the fact that the average increase of Pulse Rate of those 12 patients who had an increased rate of 10 or more than 10 beats per minute was 12 and the average increased rate of the other 37 was 1. 9 beats per minute we get a good idea of the stability of the circulation in old patients.

Guy (1) & Oliphant Nicholson (22) remarked on the fact that women have generally less postural variation than men and it is quite common to find anaemic & debilitated women with no variation at all.

Children under 16 have fast pulses and but slight

POSTURE

postural variation unless they are very debilitated. Their pulse is very mobile and can be felt to vary with respiration, and whereas a coughing attack may have little effect on the senile pulse it can increase that of the child by 20 - 30 beats per minute.

WE SHALL NOW COMPARE PULSE VARIATIONS IN CHILDREN & IN ADULTS.

(1)

Ages of Above 15 & under 40				15 years of age & under			
Age	Sex	Pulse Sitting	Standing	Age	Sex	Pulse Sitting	Standing
30	M	92	100	14	M	88	86
18	M.	76	87	14	M	88	91
33	M	101	103	10	M	84	92
17	M	106	106	14	F	110	120.
18	F	86	120	11	F	96	110
25	F	80	103	13	F	100	110
28	F	76	94	10	M	(77	83
39	F	90	100			(88	101.
29	M	80	88	15	M	81	89
39	F	86	96	11	M	108	128
27	F	100	118	11	M	(99	110
39	M	90	96			(88	103
38	F	96	96	15	F	100	107
38	M	82	86	5	M	112	110
38	M	109	117	12	F	97	98
38	M	79	86	15	M	108	114
34	F	(120	126	14	F	118	123
		(103	108	9	F	97	98
		(106	106	7	M	106	120
27	F	(80	86	7	F	98	120
		(86	90.	8	F	134	150
20	M	80	92	9	M	(70	71
32	F	90	111			(72	72
33	M	(115	120	13	F	95	96
		(125	125	9	M	91	92
17	M	(98	110	6	M	92	94
		(90	108				
29	F	(130	130	12	M	80	80
		(126	126	5	M	90	92

POSTURE.

Pulse variations contd.

Ages Above 15 & under 40

Age	Sex	Pulse Sitting	Standing
21	F	86	93
28	F	124	135
		89	89.
23	F	78	86
26	F	77	80
36	M	76	77
31	M.	79	86
29	M	70	86
30	F	105	107
18	F	82	84
25	F	66	70
36	F	118	122.
23	M	113	114
18	F	73	84
30	F	112	118
27	F	69	73.
18	M	76	87.
20	F	74	80
18	F	92	96
17	F	120	121
16	F	84	105
25	F	80	81
27	F	97	100
17	F	78	81
21	F	84	87
38	F	81	85
17	F	109	116
20	F	84	87
17	F	90	90
17	M	78	80
		70	80
		64	82
		76	85
31	M	80	92
		80	90
29	M	78	100
		82	100
		72	84
		74	92
		82	112
		100	104
18	M	76	88
18	M	84	96
17	M	80	100
19	M	82	96
26	F	64	84

15 years of age & under

Age	Sex	Pulse Sitting	Standing
12	M	80	80
5	F	120	120
10	M	78	81
6	M	129	144
7	M	114	118
12	F	121	121
12	M	97	100
		92	97.
12	F	109	119
13	M	86	90.
5	M	83	87.
12	M	84	85
13	F	118	118
7	F	81	81
		80	82.
8	M	119	124
14	F	113	120
9	M	83	80
15	M	76	77
9	M	111	128
8	M	119	125
9	F	107	106
12	M	83	93
		78	88
6	F	103	104
		105	105
8	M	97	101
6	M	72	72
12	M	90	92
9	F	102	108
7	M	100	100
8	F	108	112

In many of these children the postural variation was marked, but they were very debilitated.

In general children seem to have less postural variation than adults.

POSTURE

The postural rate of any given individual may vary within very wide ranges from day to day and from various causes.

Male age 29.

Sitting	Stand
78	100
82	100
96	103
92	108
72	84
74	92
82	112

Pulse lying in bed 55 & on standing up 88.

lying in bed 60 : sitting on edge of bed 66. standing 87:

After two minutes rest in a five mile walk on a holiday 94 sitting 108 standing.

7½ minutes after a walk of 5 miles :

88 sitting 102 standing.

After 5 mile walk 88 sitting 102 standing.

Male age 17

P. 78	sitting	90	standing.
77	..	97	..
71	--	82	--
72	--	81	--
72	--	86	--
64	--	82	--
76	--	85.	--

Shortly after 12 mile walk 72 sitting 86 standing.

Oliver says that prolonged walking speedily causes relaxation of the vaso-motor tone and in a more marked degree than cycling.

Possibly the difference in the posture in

cycling & walking may have something to do with this.

CONCLUSIONS.

(1) When the pulse rate does not increase on standing it usually follows that the Systolic Pressure remains the same or increases.

(2) Patients, who have "Hypertension" have very slight postural variation; but it does not necessarily follow that patients who have no postural variation are the subjects of "Hypertension."

(3) Where the pulse rate increases markedly on standing, it will generally be found that the Systolic Pressure has fallen.

(4). Patients with Cardiac Disease frequently show very little Postural variation.

(5.) Age is a great factor and must be taken into consideration in all results. Senile patients : young children & women, have a greater tendency to stability of the circulation than adult men.

(6) Variations are constantly occurring in the same patient, and general condition & employment have to be taken into consideration, and it is likely that a sedentary clerk of 30 will show more postural variation than a man of the same age who has pursued a laborious occupation for 12 years.

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(2) Stephens (Journal of the Amer. Med. Assoc. Vol. XL111 1904.)

(3) Huchard (La Medication Hypotensive 1903.)

(4) Graves (Clinical Lectures.)

(5) Marey (quoted by Janeway.)

(6) Knox (Edin. Med. Jour.,Vol Xl 1815.)

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(11)Thorne (Practitioner. April 1912.)

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(18) Oliver (Studies in Blood Pressure 1908.)

(19) Oliver (Practitioner 1893.)

(20) Erlanger & Hooker (Quoted by Hirschfelder.)

(21) Gibson (Brit. Med. Jour. Oct. 1906.)

(22) Olihpant Nicholson (Encyclopaedia Medica.)

(23) Lauder Brunton & Tunnicliffe (Brit. Med. Jour. Oct. 1897.)

(24) Allbutt (Allbutt's System.)

(25) Barber (Practitioner Aug. 1912.

POSTURE.

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(27) Clement Dukes (Lancet 1891)

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II

The Effect of Exertion on the Circulation.

II THE EFFECT OF EXERTION ON THE CIRCULATION.

Recent study of Heart disease, has more and more emphasised the fact that an estimation of the functional capacity of the Heart, which does not include reference to the reaction of the Heart to exertion is far from complete. Exertion speedily searches out the limits of the "field of response" and by the urgency of the subjective symptons of breathlessness, palpitation and giddiness etc, coupled with the objective signs of irregularity in rate and rhythm of the pulse, we may clearly appreciate the fact that a Heart which to all appearances is functioning normally in a state of rest, has reached the limits of its reserve power.

A tremendous amount of work has been done on this subject, and most workers have attempted to estimate the condition of the Heart by noting the effect of exertion in raising or lowering the blood pressure.

The general consensus of opinion seems to be, that mild exertion raises blood pressure, but that severe exertion or exertion in patients with failing Hearts causes a reduction of pressure, and that a lowering of Blood-pressure occurs after the exertion has ceased.

Janeway (1) holds that Blood-pressure gives us scarcely any clue to the work performed by the Heart or its functional ability; and with reference to the estimation of cardiac energy, Gibson (2) says, "to my own mind it appears rather doubtful whether some of the factors concerned can be even approximately estimated with the means now at our disposal " ..and.. "there is no definite relation between the height of arterial pressure and the amount of Cardiac Energy." Hirschfelder (3) looks upon the tests based upon changes in the pulse and ~~in the~~ blood-pressure as "uncertain and ambiguous" and sums up thus:- "nature has given us a far more delicate index in the sensations and appearance of the patient himself; sweats pallor etc," while McKenezie (4) maintains that in estimating the efficiency of the Heart by its response to exertion, the chief symptoms are subjective.

In examining the effect of exertion on the Heart I have not registered the Blood pressure by the Sphygmometer and my main objection to this method is, that while it denotes more or less clearly the limits of minimal and maximal pressures, it gives no indications as to the condition of the circulation between these two points. Thus though two patients may have a Systolic Pressure of 150 mm., in one case the pressure is fugitive and is the "virtual tension"

of a heart displaying the irritability of weakness, while in the other case the pressure is a well sustained pressure.

It may seem a strange thing at the present day to advocate the Sphygmograph. which has been pressed out by newer methods and relegated to the Historical corner, but I believe that in many respects it gives a clearer demonstration of all the events in the Cardiac cycle than the Sphygmometer. Friendly critics say that the Sphygmographic curve simply gives an approximate representation of the variations of pressure within the artery and furnishes no measure of the fullness of the vessel. Lauder Brunton (5) says "I find it useful to take Sphygmographic tracings as well as measuring blood pressure with the Sphygmometer, because one can estimate to a certain extent from the pulse tracing, the power of the Heart as compared with the resistance it has to overcome."

I consider that though it is not possible accurately to estimate the blood-pressure by the Sphygmograph, continuous tracings may show us the variations in pressure under varying conditions and give us a clearer appreciation of how the "Balance of the circulation " is being maintained. In my examinations I have used the Sphygmograph of the McKenzie Clinical Polygraph and the method used was as follows.

I took a tracing of the pulse in the sitting and erect postures, and with the instrument still on the wrist and the paper in situ as on the completion of the last experiment, I got the patient to climb up some steps (usually 20) and on his arrival I again set the clock-work in motion.

I had much greater success than I anticipated and in almost every case I was able to get a record of the pulse immediately after the completion of the exertion.

Some authors have taken tracings after exertion, but as they had first to adjust the instrument to the wrist such a considerable time must have elapsed as to detract from the value of their tracings. In my tracings, I have found that the pulse changes with such great suddeness, that the lapse of a few seconds would have lost me the best portions of what I consider my best tracings. My efforts might seem fantastic to some, but the result has been a great variety of tracings which in many cases resemble tracings obtained by other observers in various diseased conditions.

Doubt still exists as to whether the blood pressure is raised by exertion, for though the Heart is greatly stimulated, ~~still~~ the dilatation of the blood vessels in the muscular area may be so great as to neutralise the extra force of the Heart.

Janeway (1), Masing (6), Goldwater (7), Hill (8),

Hirschfelder (3), Otis (9), Edgecombe (10), Gibson (11) Cabot and Bruce (12), Allbutt (13), Williamson (14), Gordon (15), Bain (16), Brunton and Tunnicliffe (17), and Russell (18) find that exertion causes a rise of pressure, but they generally consider that it depends on the kind and extent of the exercise, mild exercise causing a rise and severe and prolonged exercise a fall. They also find that the blood pressure falls lower than at the start, sometime after the completion of the exercise. Oliver (19. 20. 21) believes that dilatation of the arteries may annul the effects of the additional pressure, and Broadbent (22) says "at first the tension in the arteries is raised and the pulse is vehement, but in a short time the artery is no longer full between the beats, and these while still sudden lose their force becoming unsustained and short"

Jellinck (23) found a rise in some cases, and a fall in others, and Karrenstein (24) found a fall of pressure in soldiers who had marched for 1 hour. Masing and Graupner (25) found that exertion caused a rise of blood pressure in normal individuals, but a fall of pressure in those with failing Hearts. Williams (26) Blake, Larrabee and Cleghorn (27) found that there was a fall of pressure in most of the Marathon runners, at the end of the race. Marey (28) found that exertion lowered the carotid blood pressure of a Horse from 108-102 mm., Schott (29) found that while one minutes' wrestling raised the Blood pressure, 10 minutes' wrestling lowered it from 123-82 mm., The pulse was of small volume, easily compressible and of irregular rhythm. The Sphygmograms show a lowering of the pressure. Oertel quoted by Morison (30) says that though the Systolic pressure was raised by exertion, the Sphygmogram taken showed what is termed a low tension pulse. Hirschfelder (31) says that "after exercise the blood pressure is increased and yet the pulse becomes more collapsing than before." Mahomed (32) and Sansom (33) also comment on the lowering in Sphygmographic tension induced in the pulse by exertion.

In the exhibition of my tracings, side by side will be found Sphygmograms taken before and after exertion, and by a comparison of the tracings, some idea of the effect of exertion on the circulation may be obtained. No change of pressure (sphygmographic) was made and the conditions were as far as possible the same at the top of the stairs as at the bottom.

As a result of my observations I should say that immediately after exertion we get a lowering of pulse tension, and the resulting tracing points to a Sphygmographic low tension pulse, with lowering of the aortic notch and speedy falling away or absence of the predicrotic wave. I have no doubt that the systolic pressure is raised, but this rise of pressure due to a short, sharp systole is extremely fugitive and a great lowering of the pressure is the rule during the

remaining portion of the pulse wave. In other words exertion is able to change the sustained wave of the pulse of high and prolonged tension to a form resembling the collapsing pulse of aortic In competence, where there may be a very high systolic pressure associated with a very low and collapsing diastolic pressure.

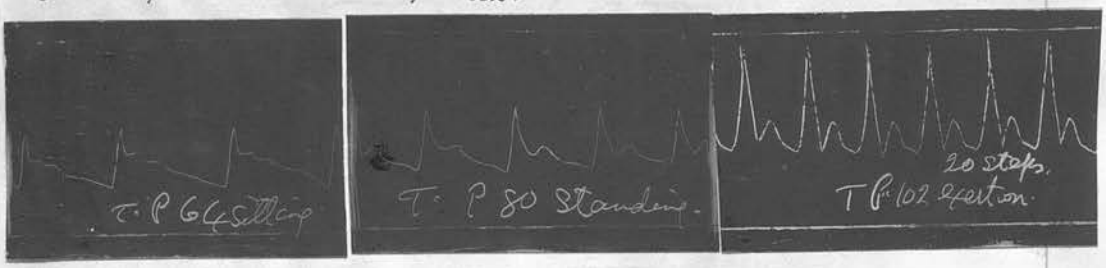
The following examples show this point.

(1)

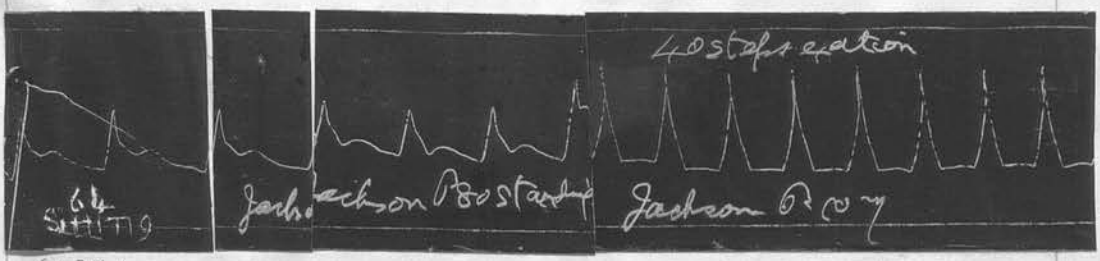
Standing

exertion.

(2)

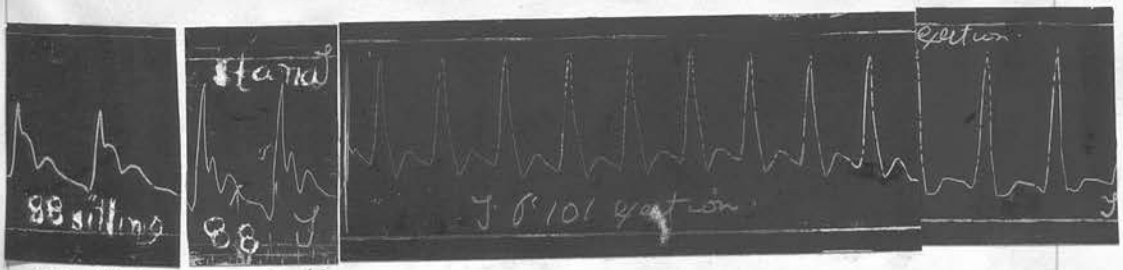


(3)



64 Sitting

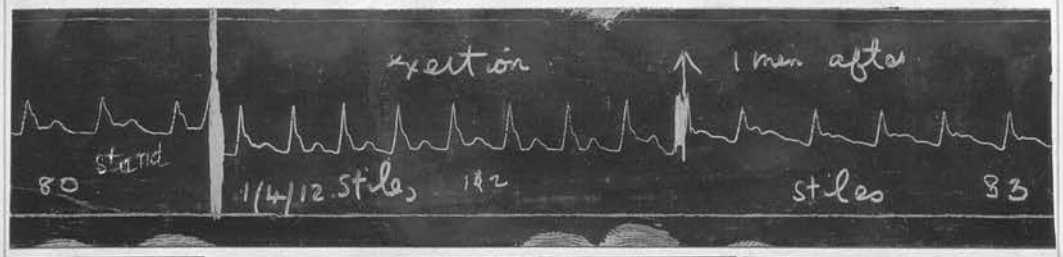
(4)



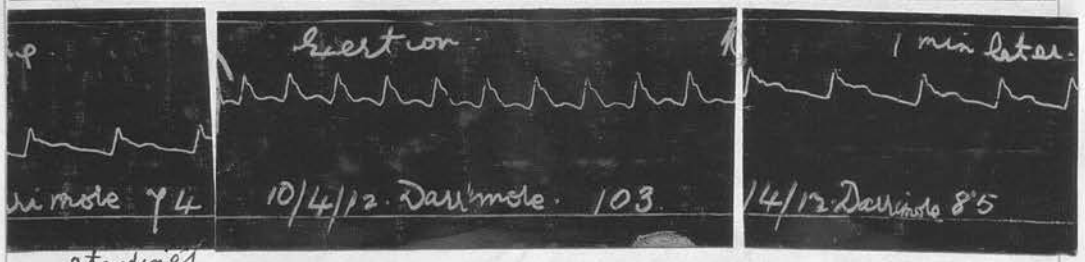
88 Sitting
88 standing.

In the next series of cases we see the gradual raising of Sphygmographic pulse tension ½-1 minutes after the completion of the exertion.

(5)

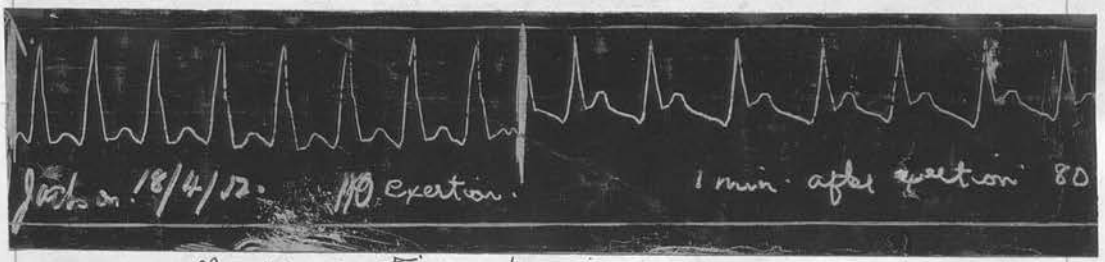


(6)



standing

(7).



all are. continuous tracings

Fig 5 male age 43. Fig 6 male age 26. Fig 7 male age 17. In this case the tension falls very low on exertion, but it will be noted that there is a marked postural variation on standing. In estimating the effect of exertion, I always compare the tracing with that obtained on standing, and though the fall on exertion found in fig 7. would be a serious fall in a patient with high blood pressure and little or no postural variation, it is of little import when we compare it with the tension found on standing.

The next tracing compares the effect on the pulse of climbing 20 and 40 steps.

(8)

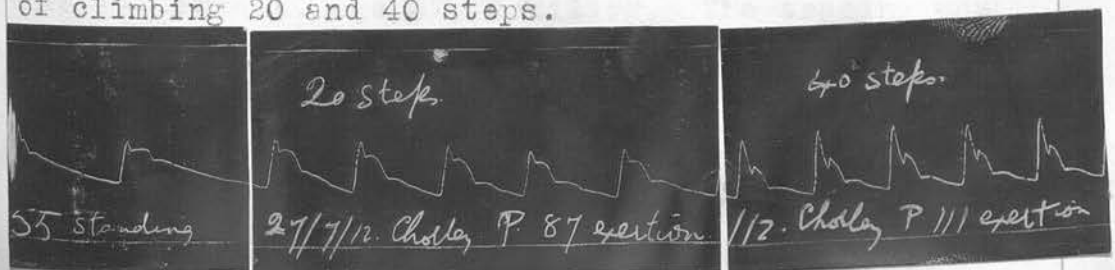
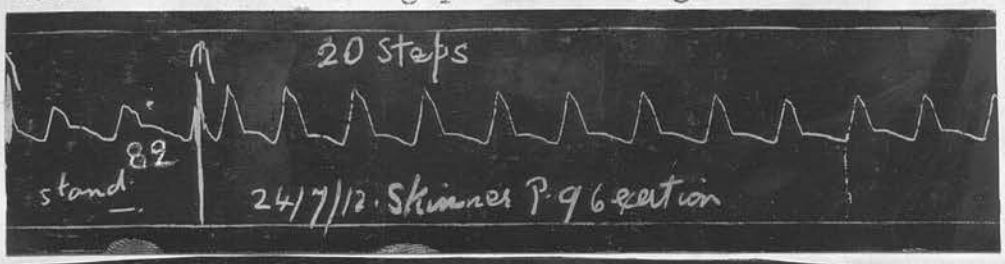
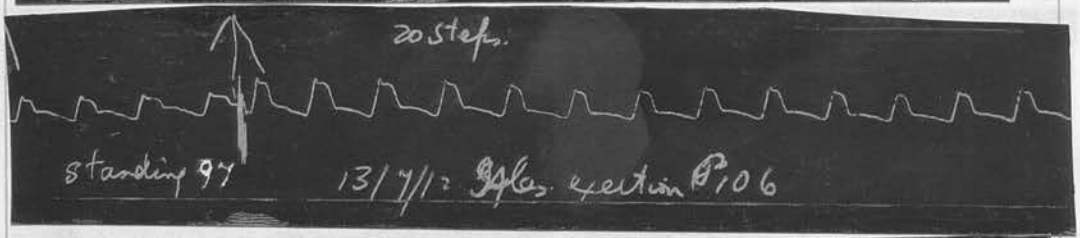


Fig 8 male age 69 arterio sclerosis.
The following patients reacted pretty favourably to the exertion. Where obtained, the Systolic Pressure (SPP) in the standing position is given.

(9)

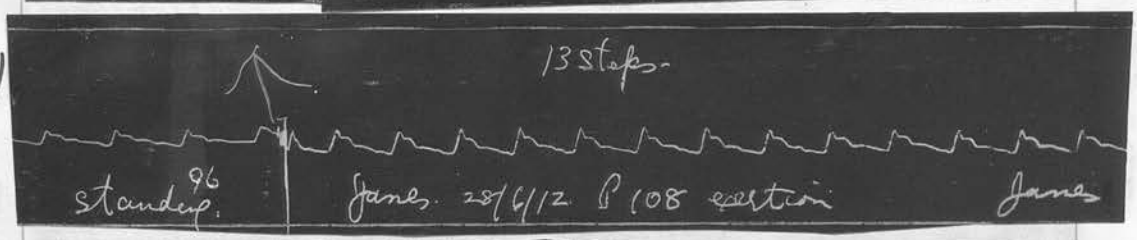


(10)



(11)

(12)



(13)

(14)

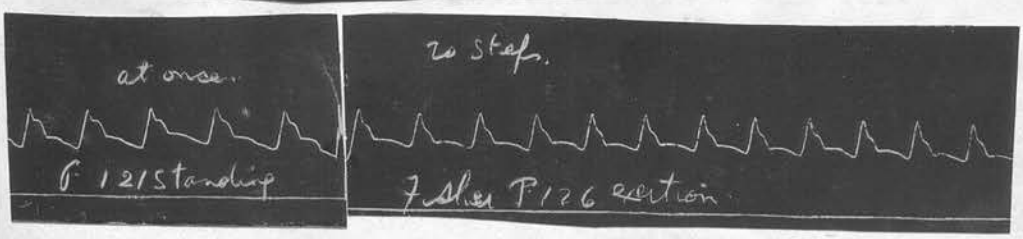


Fig 9. Male.age 38 yrs. S.P.P. 140.
Fig 10. Female. age 63. Debility and slight dyspnoea.
Fig 11. Female. age 55 years debility.
Fig 12. Male. age 39. 5 weeks after an attack of Pneumonia.
Fig 13. Female. age 57, debility. The tracing was taken shortly after she had completed a 5 mile walk.
Fig 14. Female. age 67. suffering from an Influenza Cold.

(15).

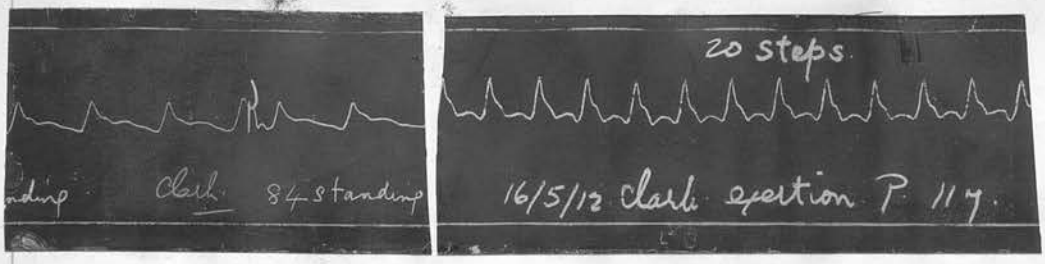


Fig 15. Male. age 29. Systolic Pressure 125 standing.

(16).

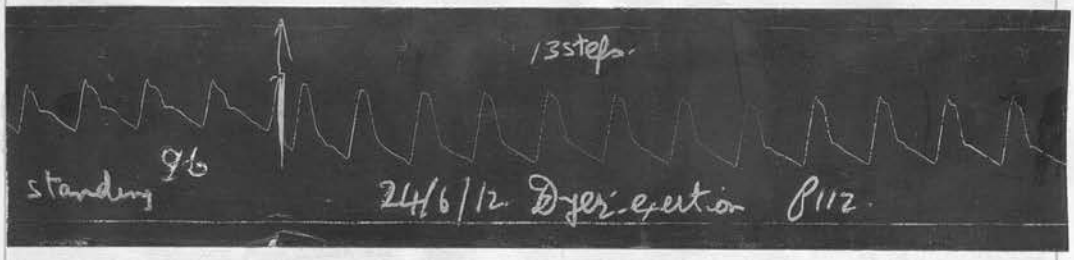


Fig 16. Female. age 38. Patient was $8\frac{1}{2}$ months pregnant. She was very anaemic and debilitated and suffered from slight dyspnoea on exertion. Note the slight variations in the diastolic period due to respiration. Systolic Pressure. 125.

(17)

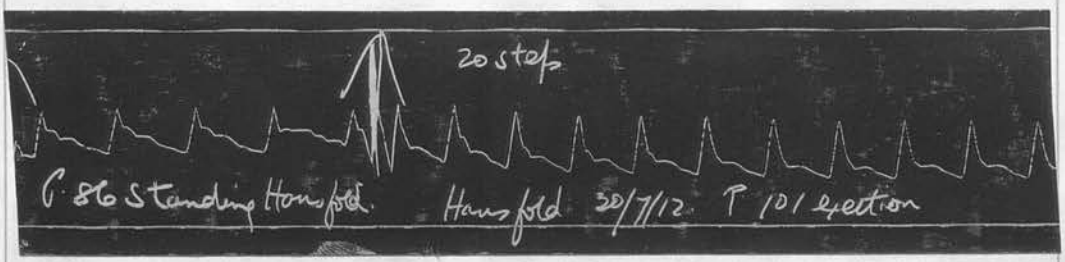


Fig 17. Male. age 38. Neurasthenia. SPP 160.

(18).

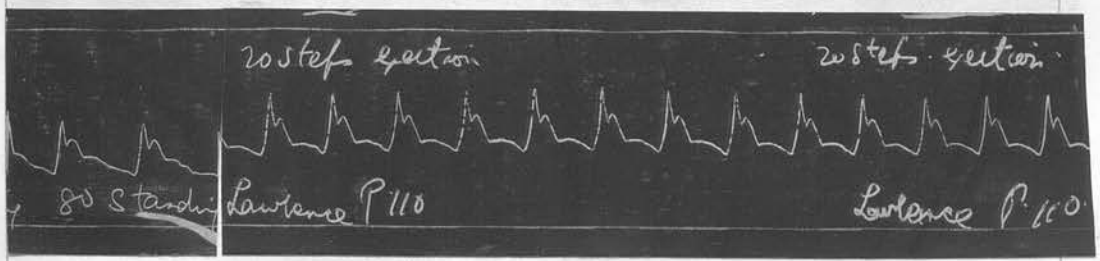


Fig 18. Male. age 43. This patient is suffering from aortic incompetence though the tracing does not suggest that. It is not a severe case and was induced by an attack of Rheumatic fever when he was 13 years. The pulse is steady and not of the "water-hammer" character; the aortic 2nd. sound can be heard at the 2nd. Right costal cartilage and it is only at the bottom of the Sternum that the diastolic murmur can be heard.

Apex $4\frac{3}{4}$ inches from the mid line. Exertion has very little effect on the pulse except that it develops a certain amount of suddenness towards the end of diastole. He is a feller of trees and his case exemplifies Hirscfelder's (31) statement, that tests of cardiac power which dont take into consideration the condition of the skeletal muscles, are fallacious. "Thus the Blacksmith with a diseased Heart may be able to do more work than the Book-keeper, with Neurasthenia, and yet, under the conditions in which he lives, even if not under the strength test arranged for the average man, the Blacksmith's Heart may be failing."

(19)

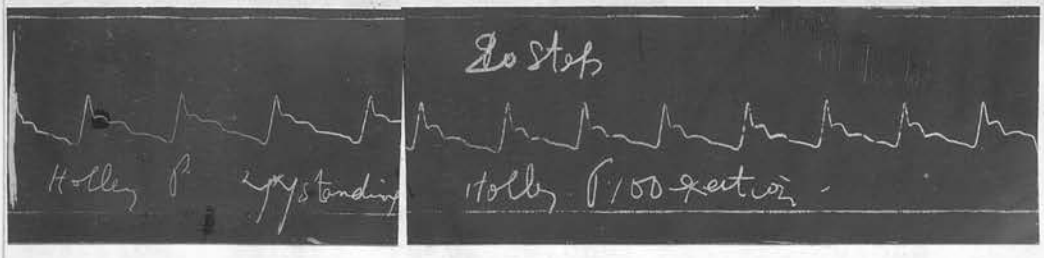
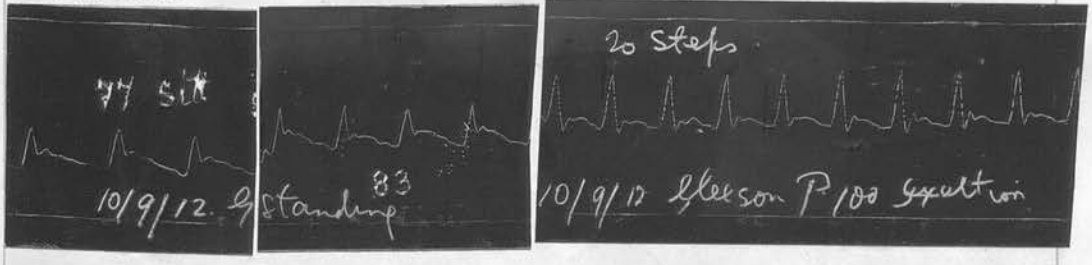


Fig 19. Male. age 36. Sys. PP. 145.

The next three tracings show the exaggerated response, found usually in the pulses of the young and due probably to instrumental error. They show suddenness of contraction.

(20)



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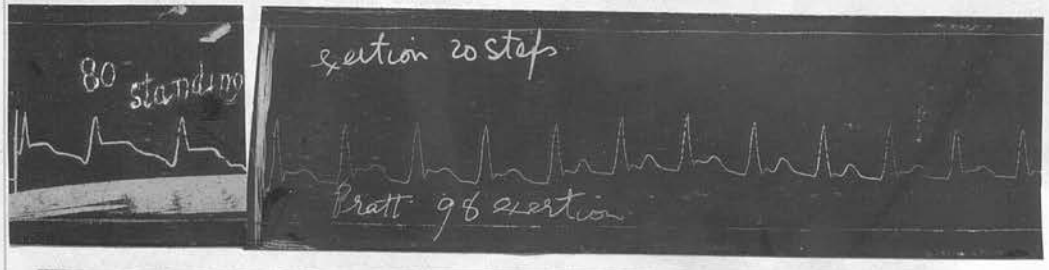


(22).

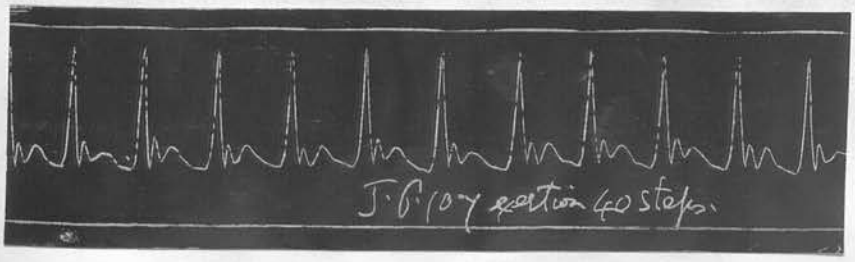


Fig 20. Male age 10. Pulmonary Tuberculosis.
Fig 21. Male age 15. SPP. 90.
Fig.22. Male age 18. SPP. 130.

The next cases are examples of High tension pulses.

(23)

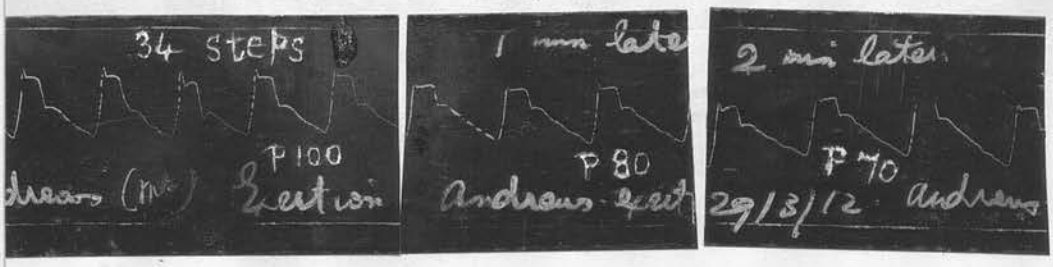


Fig 23. Male age 75. SPP. 180. Note the gradual raising of the aortic notch one & two minutes after exertion. There are occasional "intermissions" in his ordinary pulse which are not reproduced on exertion.

(24)

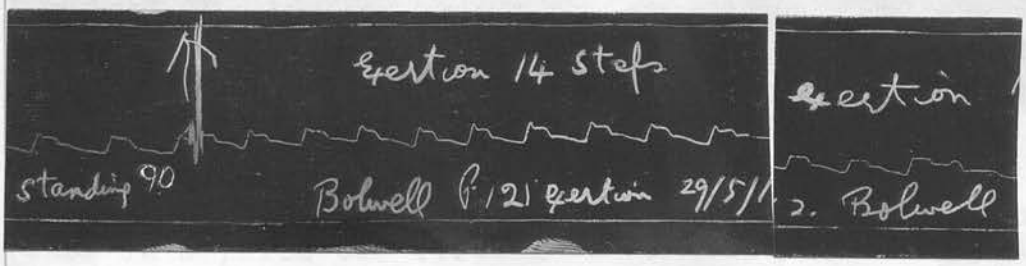


Fig 24. Female age 75. SPP. 200+. She has had Bronchitis for 20 years. "Intermissions" were found in her ordinary pulse and it will be noted that one extra systole appears on exertion.

(25).

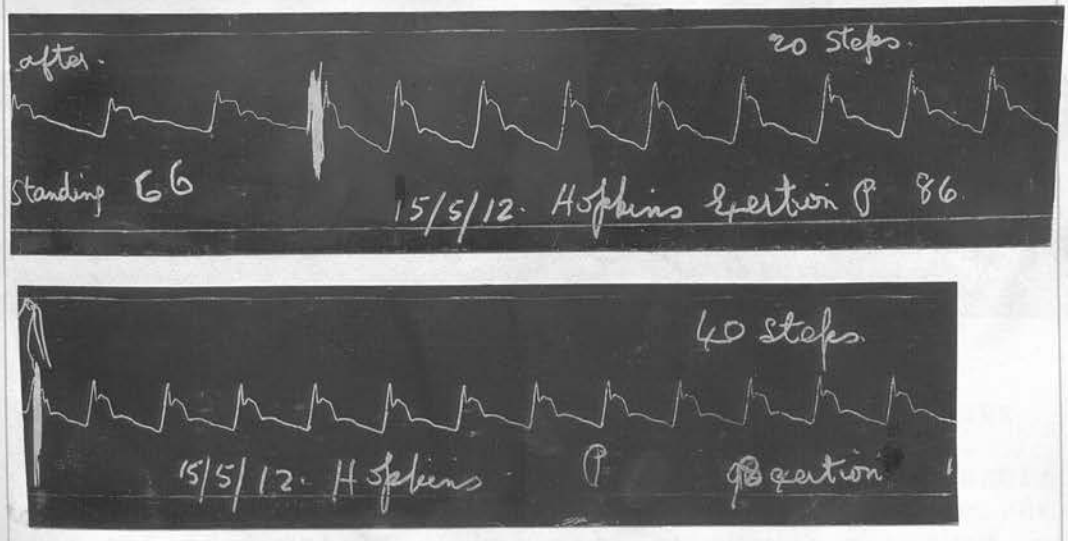


Fig 25. Male aged 74. SPP. 190. Debility. In his case it will be noted that the 40 steps had no greater effect on his pulse than the 20. He was not breathless.

(26)

Fig 26. Male age 65. SPP. 190. Tension well maintained on exertion.

(27)

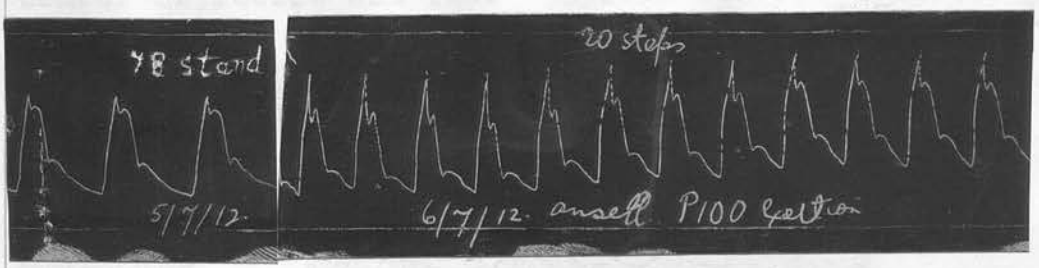


Fig 27. Female age 51. SPP. 170. Debility. Though this is a pulse of "Virtual" high tension, the tension is ~~pretty~~ fairly well maintained during exertion.

The above cases of high blood pressure show a pulse of well sustained pressure during exertion. Other cases will be shown, notably Fig (40) which do not show this.

The next cases show a fall of pressure on exertion. They are very debilitated cases.

(28)

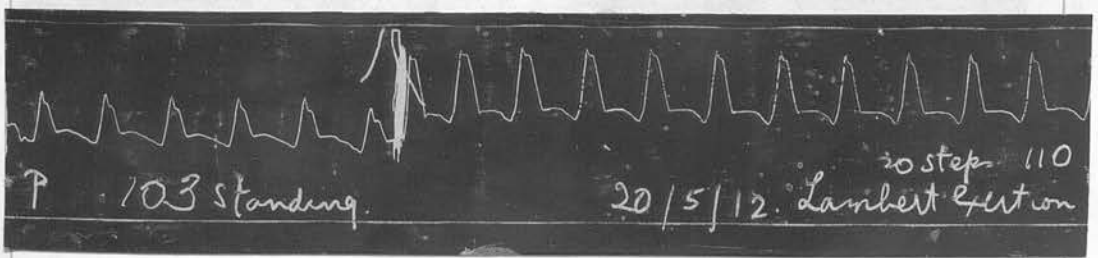


Fig 28. Male age 61. Just recovering from Subacute Rheumatism which has kept him in bed for 5 weeks. Patient is very debilitated. SPP. 120. The pressure on exertion is low and there is a sudden fall towards the end of diastole. This patient showed a marked postural variation.

(29).

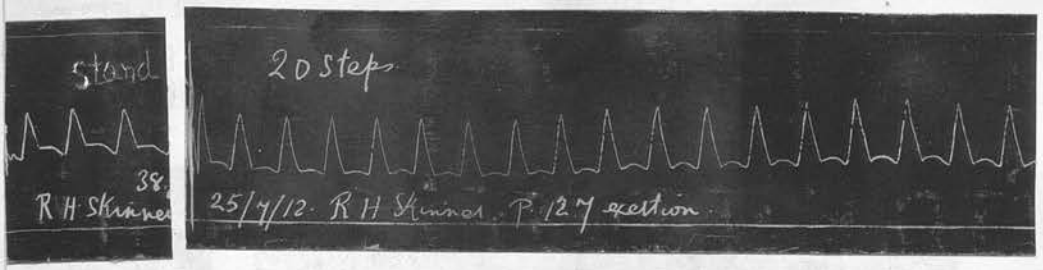


Fig 29. Male age 38. SPP. 135. This patient was in bed for 4 weeks with a Septic Throat and was very debilitated. Note the marked fall of pressure on exertion, giving the"empty condition of the circulation during Ventricular diastole", described by (Bramwell 34. 35.) McKenzie (36) says, "When an ordinary person's Heart is called on in exertion, the Heart responds by strong Ventricular contractions: in a debilitated patient the effect occurs by a greater number of feeble and less complete contractions."

(30).

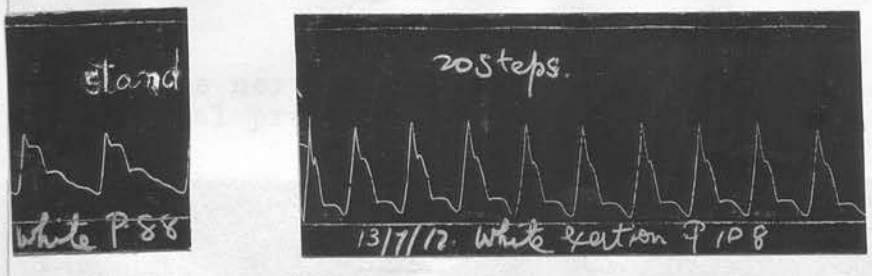


Fig 30. Male age 46 suffering from Carbuncle on the neck. Patient had a pulse of large volume and there was a suspicion of a slight aortic systolic murmur. On exertion it will be noted that the pulse has developed a character somewhat akin to aortic Incompetence.

(31).

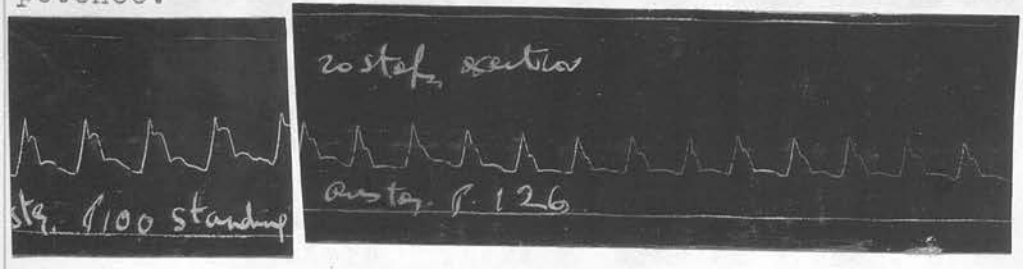


Fig 31. Female age 42: anaemic debility. The next case was taken from a patient who suffers from Asthma.

(32).

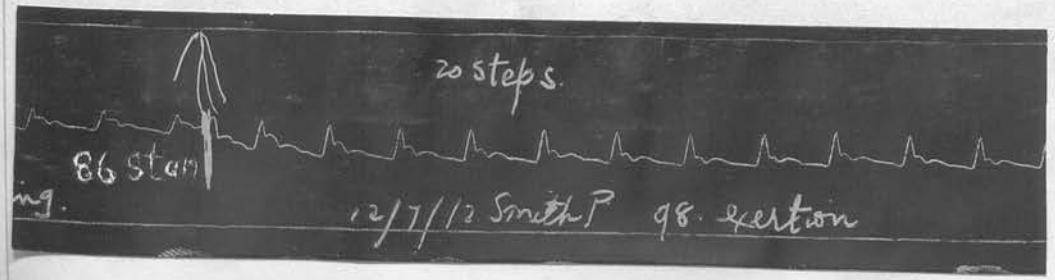


Fig 32. Male age 43. (P. standing 86
(Systolic press. 140
(Diastolic 105.
There is little change on exertion.

(33)

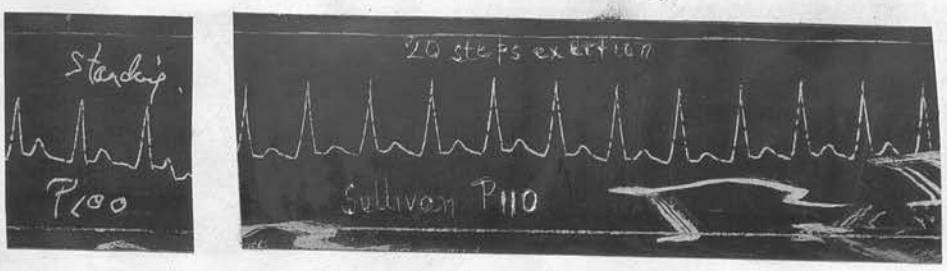


Fig 33. Male age 30. (Systolic Pressure 130
(Diastolic " 90
The Cardiac apex was at the nipple line and there was a faint mitral systolic murmur. He had been invalided out of the Navy for Rheumatic fever. In his case the pulse is quite as good after the exertion as on standing.

In the next series there is a very distinct fall of arterial pressure on exertion.

(34)

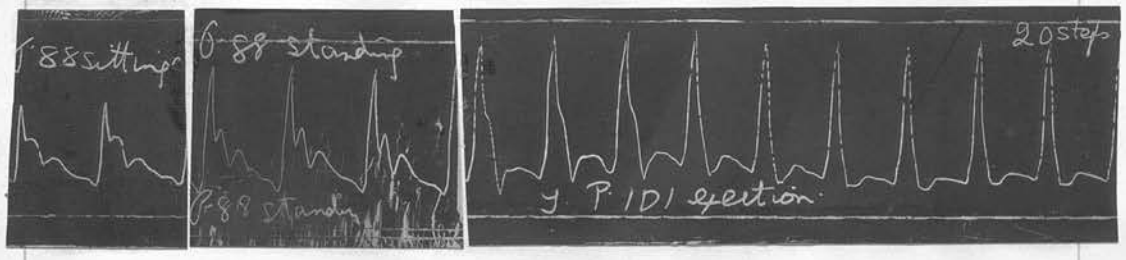


Fig 34. Male age 63. Cardiac dilatation: feeble Heart sounds: mitral systolic murmur: oedema of ankles and dilated venules around the costal margins.
(P. standing 96.
(Systolic press. 140.
(Diastolic " 90.
On exertion it will be seen that there is a very evident and distinct fall of arterial tension, the artery being apparently very empty at the end of the Ventricular systole. There is also an element of Hyperdicrotism. Such a fall of pressure in an old patient with moderately high tension, indicates a very definite element of Cardiac inadequacy.

(35)

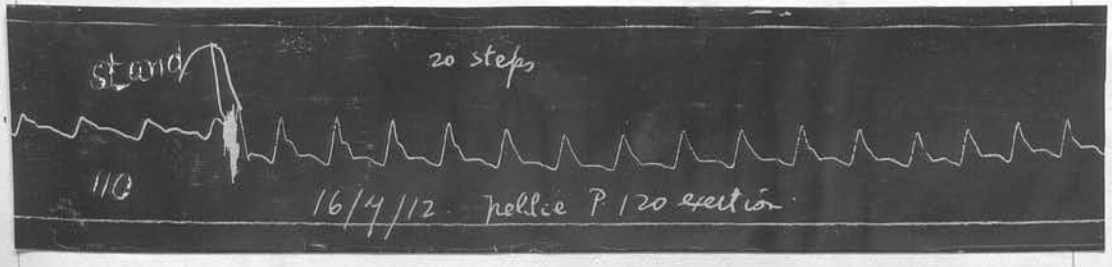


Fig 35. Female age 11. She is a healthy girl and this tracing may be compared with the next one taken from her sister.

(36).

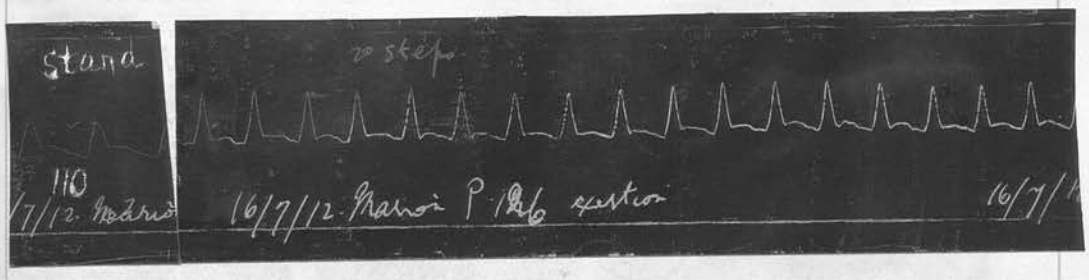


Fig 36. Female age 13. She has suffered from Heart disease for some time and is breathless on exertion. Apex at nipple line: aortic diastolic murmur heard at the bottom of sternum: and a somewhat jerky pulse. The symptoms pointed to an early Rheumatic affection of the Heart. On exertion it will be seen that the Ventricular systole is very sudden and the fall of pressure abrupt, the tension being low in diastole. The pressure is not so well maintained as in fig 35.

(37)

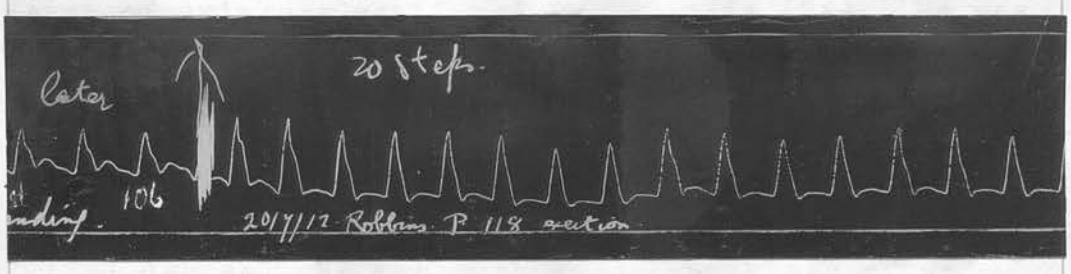


Fig 37. Male age 41. Patient suffers from Phthisis and is breathless on exertion. On exertion it will be seen that the diastolic pressure is very low and occasional smaller beats will be noticed, notably the seventh and 8th, also the 11th. and 12th. and ~~also~~ 15th., the irregularity being evidently due to Respiration. This form of irregularity on exertion is commoner that the "Pulsus alternans" and is probably a mild form of "Pulsus Paradoxus." The ordinary pulse is markedly dicrotous and the effect of posture is shown in Section 1. He was a Bath chairman and in spite of the evident inadequacy of the circulation, continued his employment. He died of advanced Phthisis 5 months later.

(38)

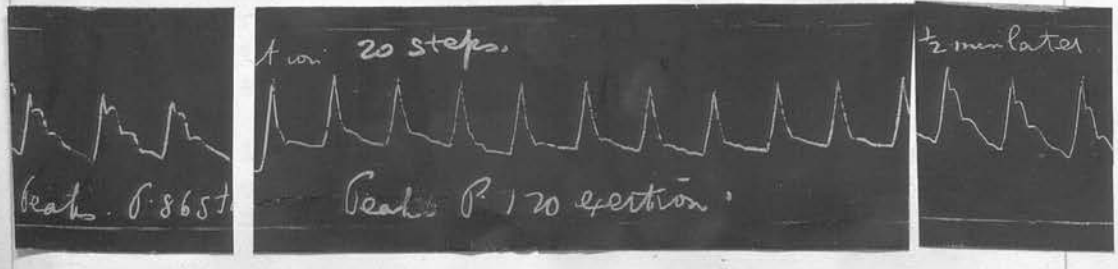


Fig 38. Female age 69. She is suffering from Cardiac and general debility with breathlessness and giddiness. The pulse is one of "Virtual tension". On exertion the tension falls considerably and there is a good deal of Respiratory irregularity. Note the augmentation of tension that occurs ½ minute afterwards.

(39)

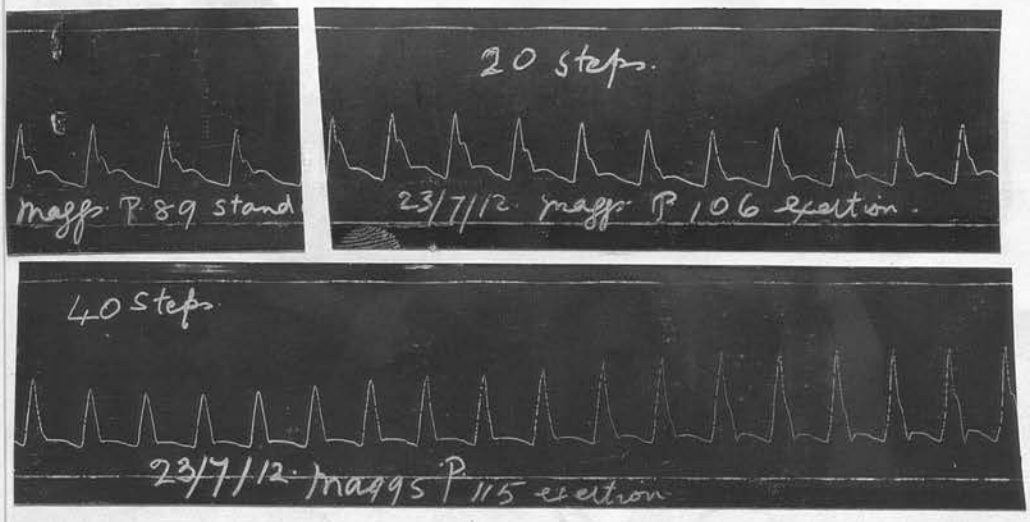


Fig 39. Male age 47. This patient has been an alcoholic for a great number of years and has the irregular Heart of drinkers mentioned by McKenzie (36). He was under treatment ~~for~~ 10 years ago for "palpitation". There are a number of dilated venules round the costal margins. On exertion (20 steps) the pulse tension is fairly well maintained, though the 6th. and 7th. pulsations show Respiratory influence; but after 40 steps, the pulse tension has fallen considerably and the early pulsations show Respiratory influence to a marked degree. He was much more breathless after climbing 40 steps.

(40)

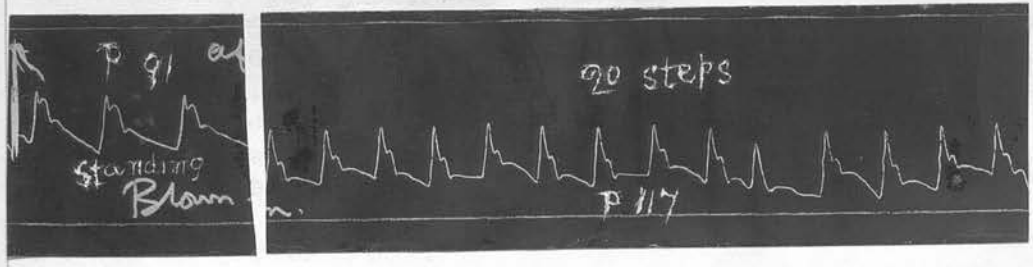


Fig 40. Female age 69. (P. standing 91
(Systolic Pressure 180.
She suffers from Bronchitis and Emphysema and has done so for the last 25 years. She occasionally gets syncopal attacks. On exertion it will be seen that there is a great fall of pulse tension and great Respiratory irregularity, no two beats being alike. There is an'extra systole' at the 10th. contraction. She was very breathless on exertion and the Inspiratory and Expiratory Variations must have been very great to affect to such an extent, a pulse with a systolic pressure of 180 mm. It approaches to the

description given by Mahomed (32) of a case of Heart failure in Typhus Fever. "Each contraction of the Heart varying in power from the preceding one: the pulse altering its characters at each pulsation, being sometimes not fully dicrotic, ~~and~~ at others hyperdicrotic, and at another monocrotic. The Respiratory line is undulating."

(41)

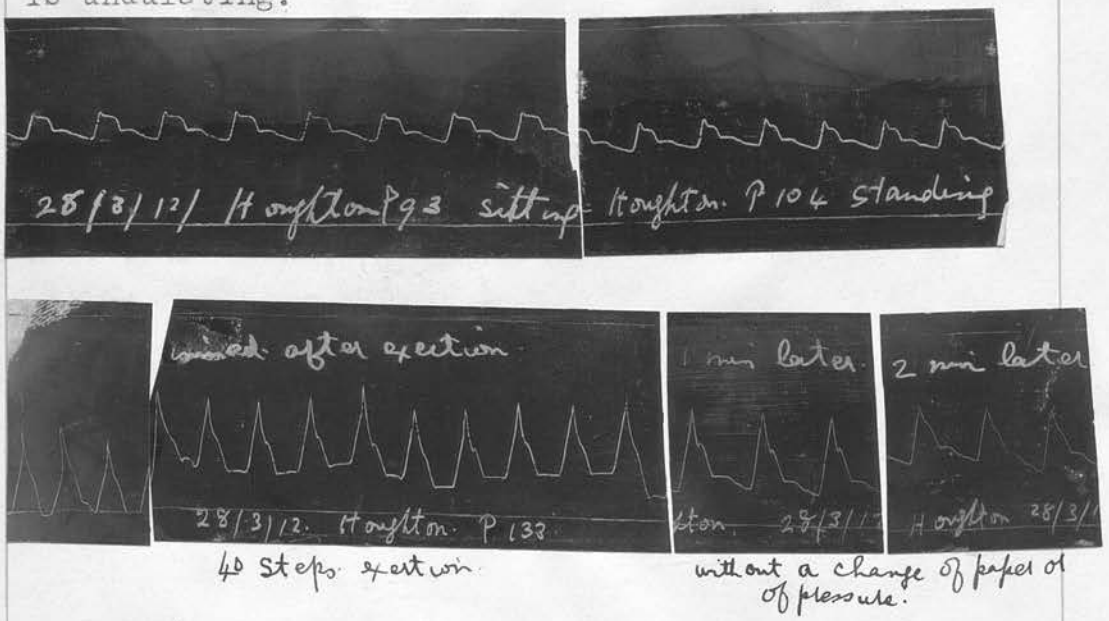


Fig 41. Male age 72. (P. standing 104
(Systolic Press. 150
(Diastolic " 95

Cardiac apex 4½ inches from the mid line: Heart sounds obscured. He weighs 14 stone and has Ruddy cheeks. He had Rheumatic fever 10 year ago. He was not a patient but he had so much dyspnoea on exertion that I took the above tracing. Note the great fall of tension on exertion, the artery being apparently practically empty during diastole. The first 2-3 beats approach the monocrotic variety and others are hyperdicrotous. The pulse is markedly affected by Respiration. The augmentation of pressure one and 2 minutes afterwards will be noticed. In this case probably the 'suction' action of the Left Ventricle is feeble & does not admit of an adequate quantity of blood for a proper circulation. The dyspnoea on exertion was extreme.

(42)

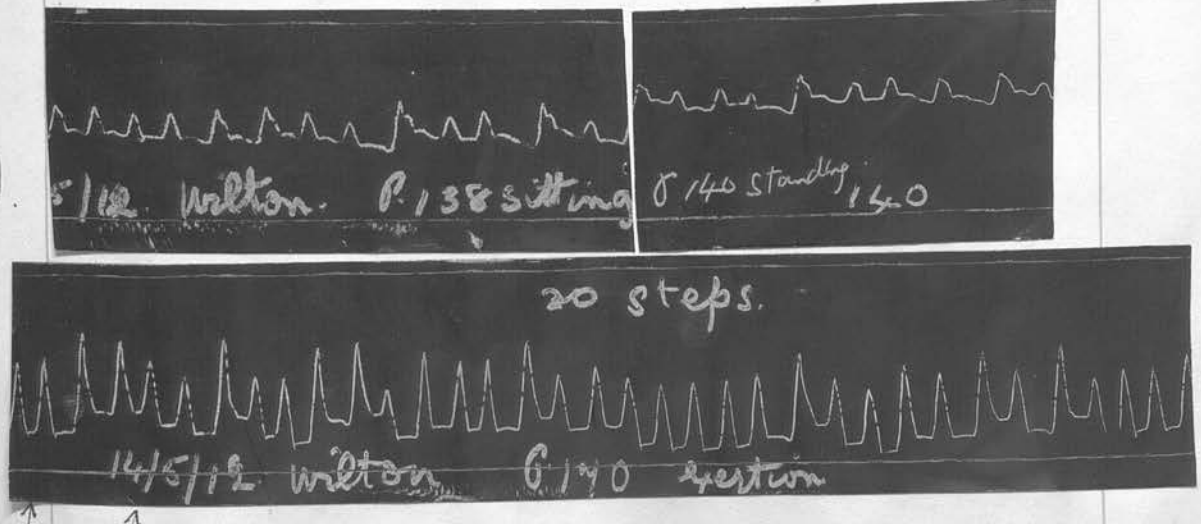


Fig 42. Female age 63. She has been feeling weak and breathless for some considerable time, but has not taken to bed. She walked one mile in to the Dispensary. Cardiac apex 4 inches from the mid line: pulsation violent, with every 3rd. beat or so stronger: mitral systolic murmur: oedema of both legs: slight Bronchitis: and blueness of the lips.
P. standing 140
Systolic Pressure (strongest) 170
The great irregularity of the pulse obtained in the sitting and standing postures will be apparent, but on exertion an extremely irregular pulse is found which varies greatly in pressure and which is apparently very empty during the diastolic period. It resembles tracings shown by McKenzie (36), Bramwell (35 & 36), Sansom (33) Oliphant Nicholson (37), Steell (38) descriptive of Heart failure and usually found in the last stages of Pneumonia.

(42) a

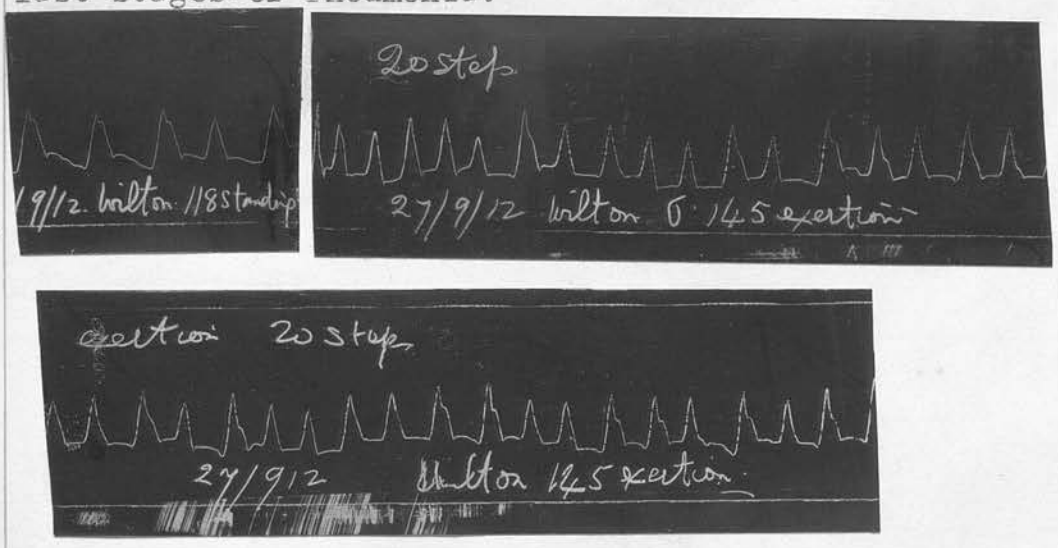


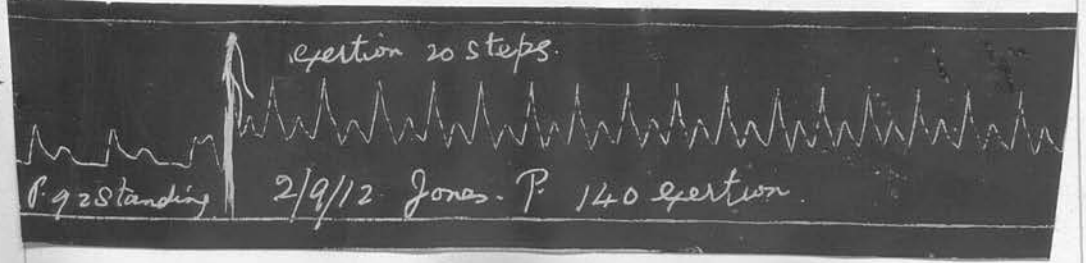
Fig 42(a) shows the tracings taken from the same patient 4 months later. The pulse is steadier and on exertion the arteries are better filled and there is much less Respiratory irregularity.

The last few cases show a well marked fall of tension on exertion and in this respect they resemble the tracings obtained by Schott (29), Oertel (30) and Cleghorn (27) after severe exertion.

However much the value of Sphygmographic examinations might be doubted, I think it may be said that some of these cases shown, indicate marked Cardiac inadequacy.

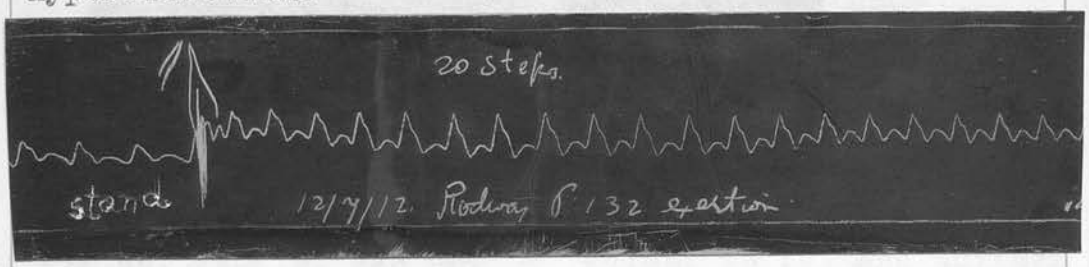
In the next set of tracings many examples of varying pressures on exertion will be found.

extra



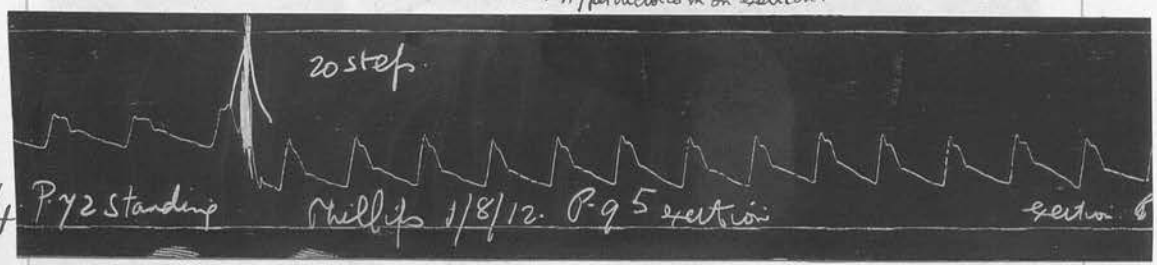
Extra.
Fig. ~~40.~~ Male, age 20. (P. standing 92.
(Systolic Press: 120
(Diastolic " 90.

Patient conplains of pains round about the Heart, and thinks his troublesmay have been caused by smoking. The apex is in the 5th. Interspace 4 inches from the mid line: the pulsation is diffuse and the Cardiac sounds are ringing, all indications of a slight Cardiac dilatation.. On exertion the systole is very sharp and the pulse very markedly dicrotous and inclined to hyperdicrotism.



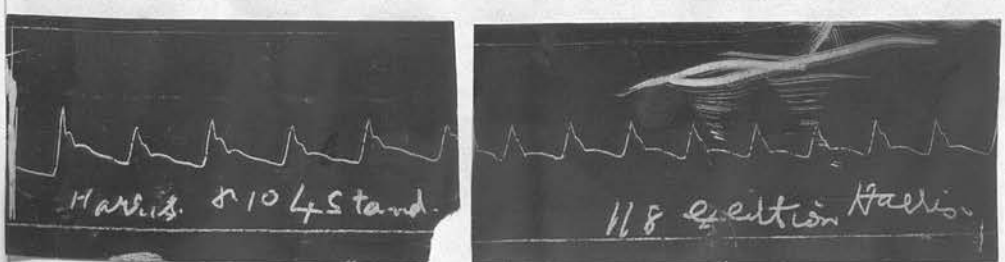
43

Fig 43. Female aged 14. There is a well marked mitral systolic murmur but the Apex of the Heart does not extend beyond the nipple. On exertion the pulse varies considerably and is hyperdicrotous in places, but there is that tendency in the pulse of Youth.
Its Hyperdicrotism on exertion.



44

Fig 44. Female age 69. She suffers from Bronchitis and occasionally has oedema of the ankles.
(P. standing 72
(Systolic press: 140.
(Diastolic " 85.
On exertion the tension is well maintained and though there were some "intermissions" in the ordinary pulse, they are not reproduced on exertion. There is some respiratory variation, notably at the 2nd. last beat.



45

Fig 45. Female age 80. She has been having M.V. of the Tincture of Digitalis for over a month. There are occasional "intermissions" which are not reproduced on exertion. The ordinary pulse partakes somewhat of the 'Pulsus Alternans' variety and on exertion the tension falls considerably and there is respiratory variation..

46

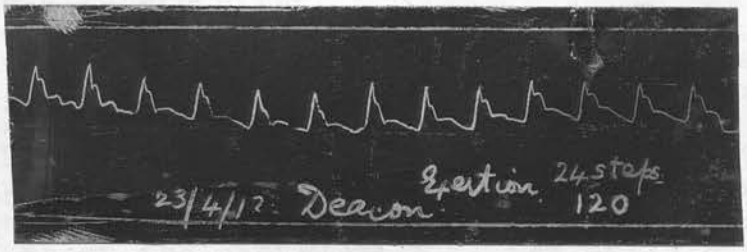
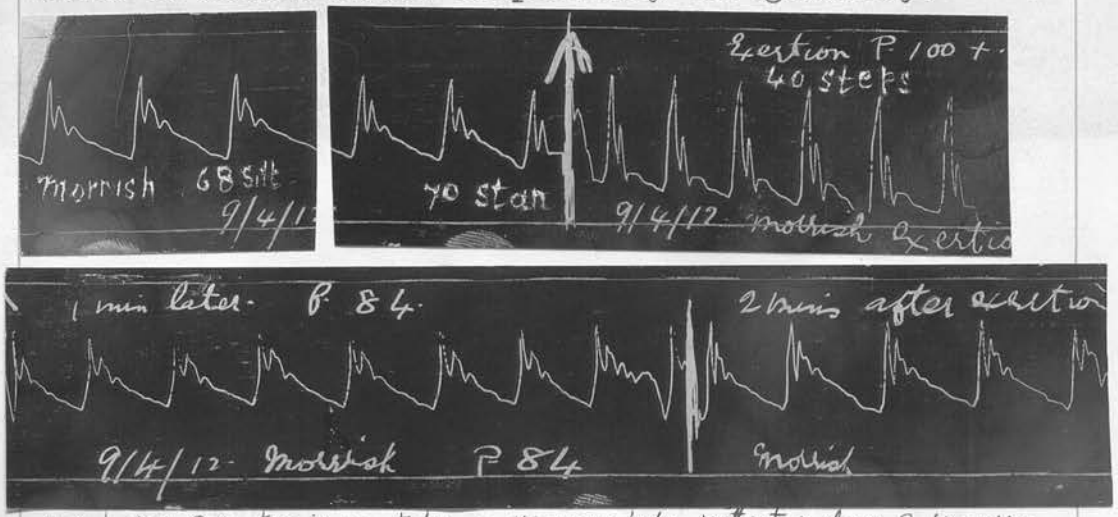


Fig 46. Female, age 52. Patient is fat and suffers from Dyspnoea on exertion, when it will be seen that there is considerable respiratory irregularity.

47.



Every portion of this tracing was taken on the same paper without a change of pressure.

Fig 47. Male, age 55. He has just recovered from an attack of acute Bronchitis. (P. Standing 70.
(Systol. Press: 150
(Diast. " 100.
On exertion the pressure falls considerably and there is a good deal of respiratory irregularity in the portion of the trace shown. Note the augmentation of pressure 1 and 2 minutes after exertion.

48

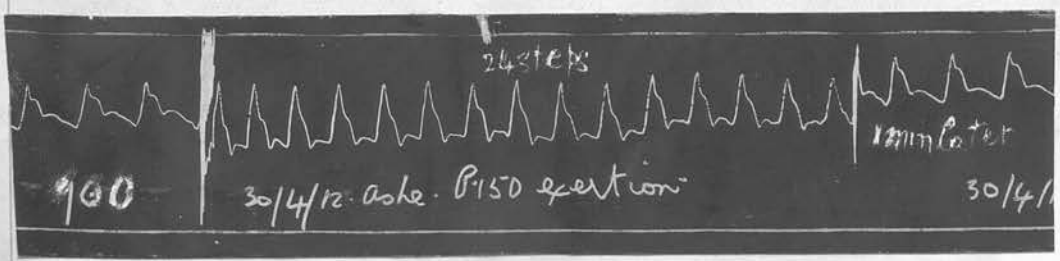
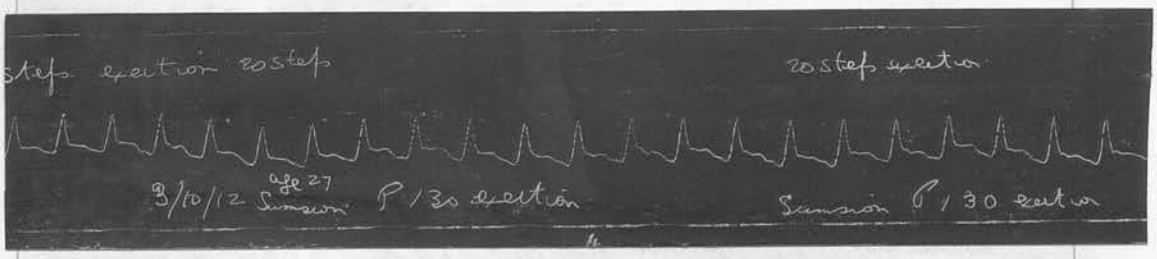


Fig 48. Female, age 39. The tracing was taken shortly after the patient had got up after a month's stay in bed for Subacute Rheumatism. She had Rheumatic fever 23 years ago, with the result that she now has Mitral Stenosis. It is however not a severe form and the apex is within the nipple line and $3\frac{1}{2}$ inches from the mid line.
(Pulse standing 100.
(Systolic press:120.
(Diastolic " 80.
On exertion there is a marked fall of diastolic pressure, the trace showing respiratory undulations and also Hyperdicrotism. A similar trace is thus described by Mahomed (32). "It shows one bad point, it is slightly hyperdicrotic and in Heart disease this may always be attributed to excessive venous congestion and shows the obstruction to the circulation to be very great." Note the augmentation of pressure one minute afterwards.

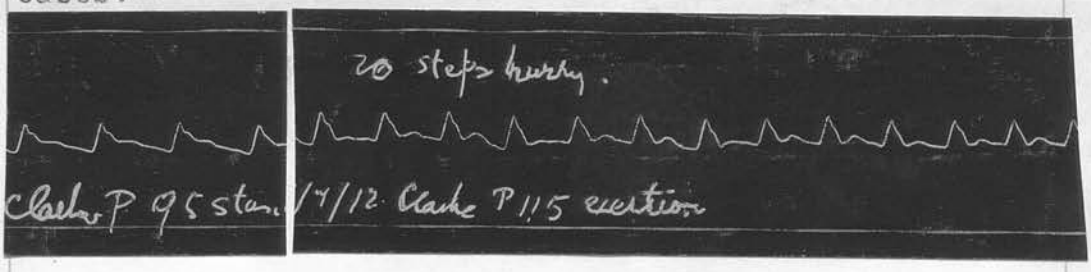


49

Fig 49. Female, age 27. She suffers from Mitral Stenosis and the Cardiac apex is 4 inches from the mid line. The change in the pulse on exertion was not so marked as I expected, but it will be seen however, that there is a well marked respiratory undulation, with variation in the strength of the beats. Of a similar pulse Mahomed (32) says "note the large proportion the percussion wave beats to the tidal - the latter being hardly discernible - and also the fullness of the artery during diastole. The Heart is contracting sharply and shortly, impelling only a small amount of blood into the arteries by each systole owing to the free regurgitation. (mitral) The diastolic expansion of the artery is well sustained by reason of the venous engorgement." (Mahomed)

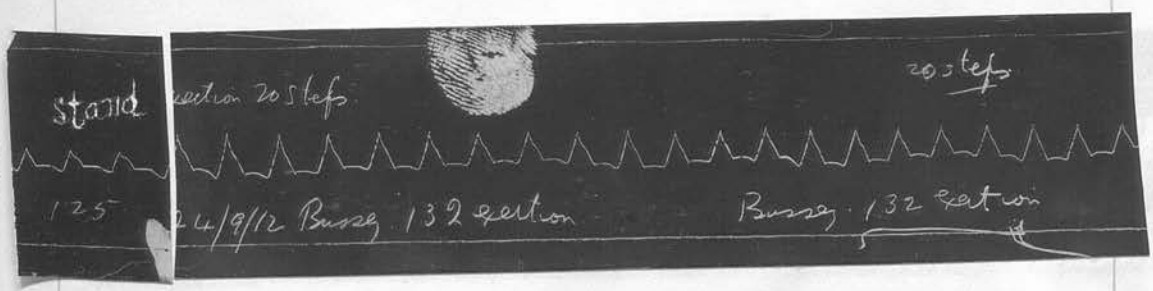
50

Fig 50. Female age 71. She is suffering from Bronchitis with marked dyspnoea on exertion. She has oedema of the ankles: blueness of the lips: Cardiac apex 4¼ inches from mid line, with weak and diffuse apex beat and a mitral systolic murmur. She feels giddy. (P. standing 110.
(Systol. Press: 130.
(Diastol. " 90.
On exertion the great irregularity in the pulse will be noted, the variations being most pronounced in diastole. Examples of incomplete beats are also seen and in this respect the tracing resembles that taken by Bramwell(35) during an attack of Asthma, and by Sansom (33) from a case of Mitral Stenosis and Incompetence. The second portion of this continuous tracing, though still irregular is comparatively regular as compared with the first portion, and a comparison of the two gives an excellent demonstration of the rapidity with which the pulse settles down to its usual condition after the exertion is over. It also hints at the possibility of extreme forms of irregularity during exertion in some cases.



51

Fig 51. Male, age 44. Bronchitis: Emphysema and Pulmonary Tuberculosis. On exertion respiratory undulations and variations will be noted. He ran up the stairs however.



52

Fig 52. Male, age 33. (P. standing 125.
(Systolic Press. 110.
(Diastol. " 80.
This patient has well marked Pulmonary Tuberculosis affecting both lungs and develops a temperature of about 100° at night. He has a considerable amount of Bronchitis and diffuse moist crepitations. The ordinary pulse is of low tension, but on exertion it will

be seen that there is a marked lowering of tension an empty condition of the arteries during diastole, and marked respiratory variations.

53.

Fig 53. Female, age 59. General debility.
(P. standing 102
(Systolic Press. 160
(Diast. " 110
On exertion there is some respiratory variation.

54

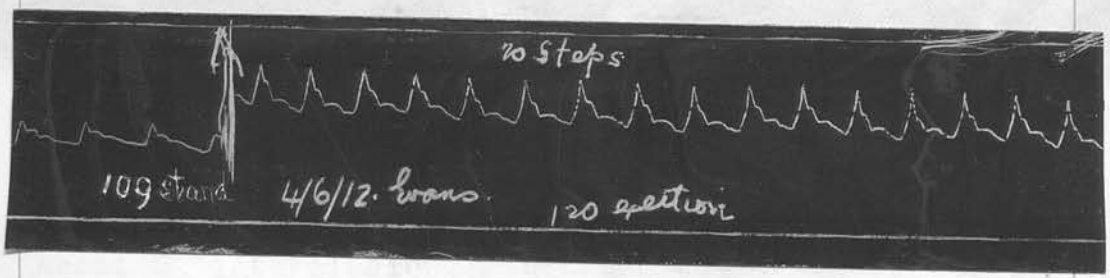


Fig 54. Female, age 62. She had Bronchitis: oedema of the ankles and a suspicion of a Mitral systolic murmur. On exertion there is a considerable amount of respiratory irregularity and variation in the diastolic pressure. This patient improved, but 5 months afterwards she developed acute Bronchitis with dilatation of the Heart, and died after being ill for 3 weeks.

55.

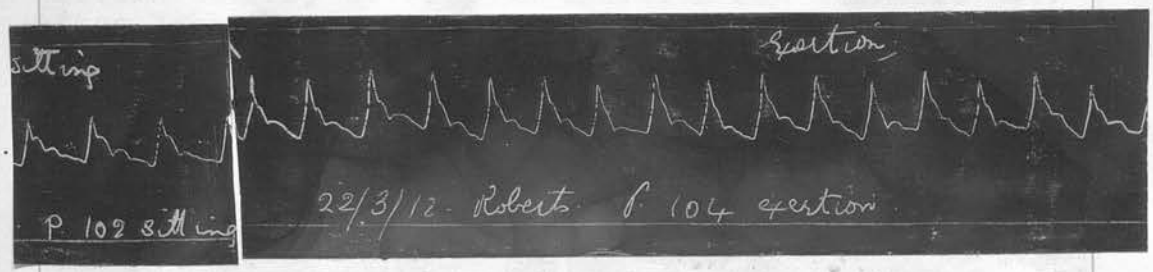
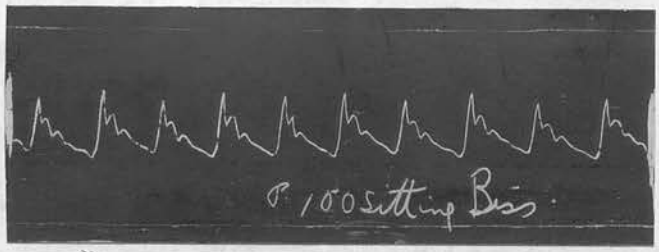
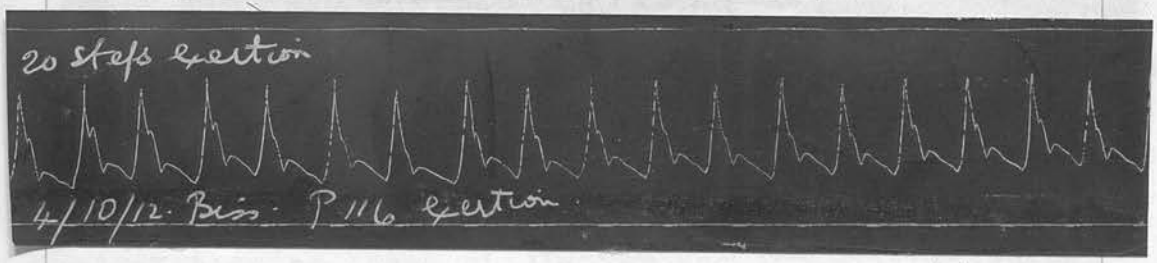


Fig 55. Female, age 80. Patient suffers from Heart failure, with marked cyanosis: oedema of legs and ankles, and urgent dyspnoea. The Cardiac apex was 4 inches from the mid line and there was a Mitral systolic murmur. Patient wouldn't go to bed and occasionally walked across the room. This had the effect of making her develop marked cyanosis, and by placing the Sphygmograph on her wrist I was able to get a pulse

tracing after one of these walks. Note the marked irregularity in the pulse, the diastolic expansion remaining very low in some instances. It will be seen that a kind of 'Pulsus Alternans' develops, but it is not a regular form and though alternate beats may be similar for a time, two, more ordinary beats are interposed on occasions. This is the most common form of 'Pulsus Alternans' after exertion, - an irregular form.

56





To the Dispensary

Fig 56. Male, age 71. Patient had hurried in, and had covered his mile and a half at a speed much beyond his usual, with the result that he was somewhat exhausted, and the pulse rate was 120 sitting and standing, with about 2 "intermissions" to the minute. I was unable to get a pulse tracing at the time but got one 20 minutes later when the pulse was still fast though slowing down to 100 sitting and standing. The ordinary pulse demonstrates to a certain degree the characters of "Pulsus Alternans". On exertion there are respiratory variations and also the developement of 'Pulsus Alternans' but it is not quite regular, for while the sequence at first is 3rd, 5th, 7th, and 9th, it changes at that stage and becomes 10th, 12th, 14th, 16th, and 18th. Clifford Allbutt (13) thinks that 'Pulsus Alternans' may develop on exertion and McKenzie (39) says "exhaustion from bodily exertion may cause 'Pulsus Alternans' and in patient with a regular pulse developed 'Pulsus Alternans' after going up 2 flights of stairs." I have found that the form developed is not quite so regular as the 'Pulsus Alternans'.

57.

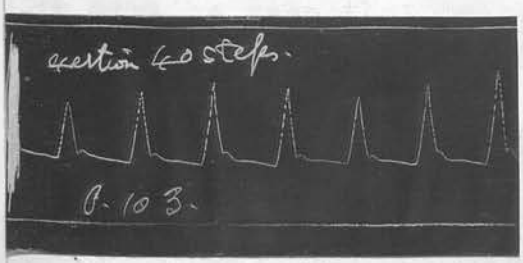


Fig 57. Male, age 18. The tracing to the left was taken when the patient was not feeling very fit, immediately after a 2 hour's sleep in the afternoon - Broadbent. (22) says "The circulation runs down in vigour as well as in frequency by a long night's sleep" and those unaccustomed to a heavy afternoonsleep feel rather miserable when they waken up. It will be seen that the tension is low and that the pulsations vary in size. The figure to the right represents the normal trace.

58

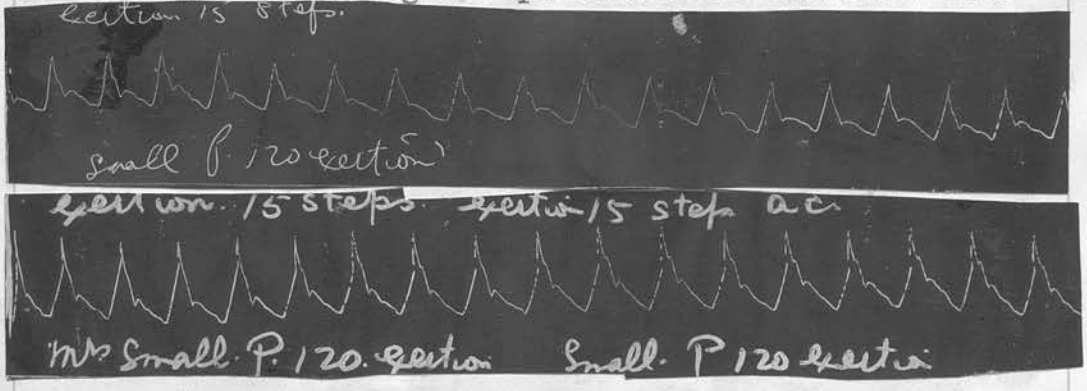


Fig 58. Female, age 73. She suffered from Bronchitis and was cyanotic, respirations 40: Pulse 102. The first tracing shows undulation and irregularities especially in the diastolic period. The second tracing taken after she had been under treatment for a month (Cardiac tonics), shows a more regular pulse; a higher tension during diastole, and a more powerful systolic expansion.

59

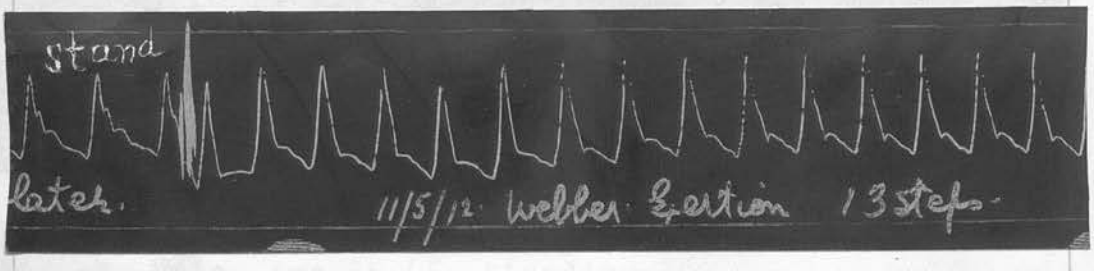


Fig 59. Female, age 65. Debility, general and Cardiac, with tendency to occasional oedema of the ankles. She has dyspnoea if she exerts herself. P. Standing 98
Systolic Press: 130.
Diastol. " 95.
The tracing undulates and varies with respiration, and it will be seen that in proportion to the other parts of the tracing, the systole of the Heart is quick and powerful.

60

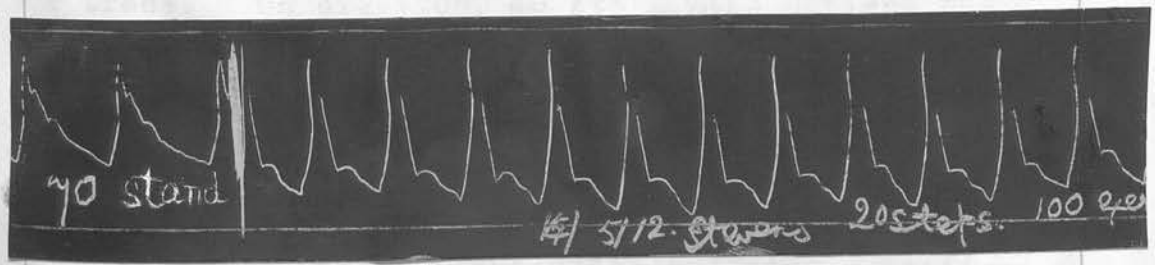


Fig 60. Male, age 79. (P. standing 70.
(Systol. Press: 150.
(Diastol. " 75.

This patient developed Bronchitis for the first time 6 weeks ago and the Heart was also affected; dilatation with Mitral Systolic murmur and great irregularity supervening. His condition improved and he was able to get about again and the above tracing was taken. Note the sudden and powerful contraction of the Heart and the varying pressure in diastole. Masing (6) says that the greatest rise in pulse pressure on exertion occurs in old and feeble patients and Gordon (15) shows that the most immediate rise of pressure on exertion occurs in patients with compensated Heart lesions. The last three cases exemplify powerful ventricular contraction of an unsustained character on exertion, occuring in patients with weak Hearts, but this is most marked in fig 60.

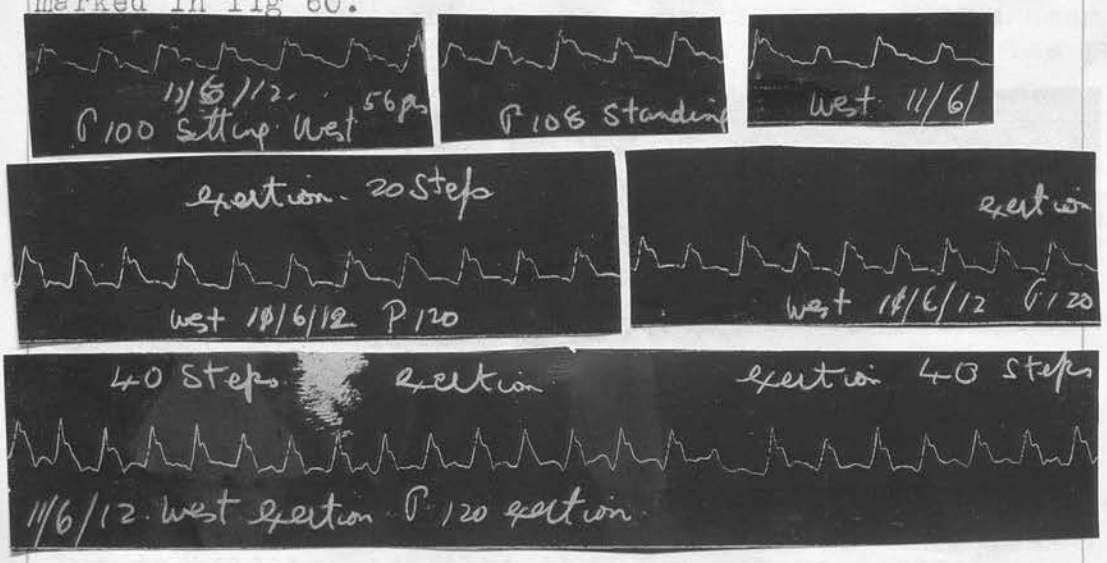


Fig 61. Male, age 56 (P. standing 108.
(Systolic Press: 170
(Diastol. " 140

Patient is an alcoholic with a well marked "grog blossom"; tremor of hands and tenderness along the nerves of the limbs. Cardiac apex at 6th Interspace 4¼ inches from the mid line: diffuse apex beat and a soft Mitral systolic murmur. There were some "intermissions" in the ordinary pulse. It will be seen that in the ordinary pulse on standing there is the development of 'Pulsus Alternans'. On exertion, 20 steps, the diastolic pressure falls very low and there is the development of 'Pulsus Alternans' towards the end of the trace. On exertion, 40 steps, the patient was much more breathless: and the diastolic pressure has become lower still, with a tendency to hyperdicrotism; variations occur in diastole; an extra-systole occurs and thereafter 'Pulsus Alternans' develops. The Heart failure in this case undoubtedly owes its origin to Alcohol.

Though numerous cases have already been cited in which an irregularity found under ordinary conditions did not appear on exertion, the following examples

illustrate this point graphically and show that the irregularity either does not appear or is made no worse by exertion.

62

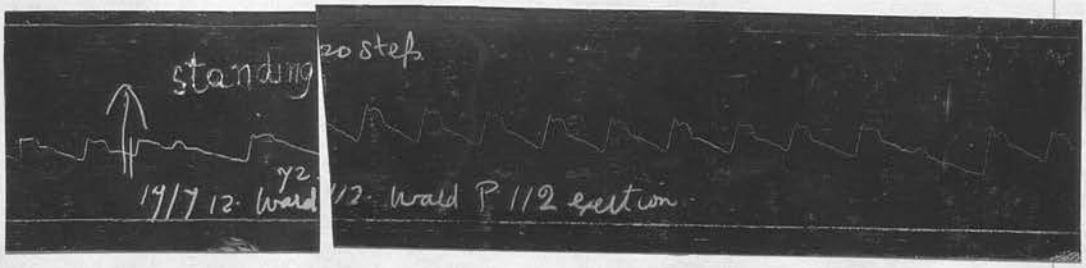


Fig 62. Female, age 72. She suffers from dyspnoea, and there is slight Cardiac dilatation with oedema of the ankles. Irregularities were 'felt' in the pulse. On standing before exertion one extra systole can be seen and another occurs on exertion. The tension of the pulse is well maintained.

63.

Fig 63. Male, age 75. Mitral systolic murmur. There were occasional "intermissions" in the ordinary pulse, but it will be seen that they are not reproduced on exertion. The tracing is somewhat undulating.

64

Fig 64. Female, age 67. The Rhythm is somewhat undulating, but there are no irregularities in the rate.

65

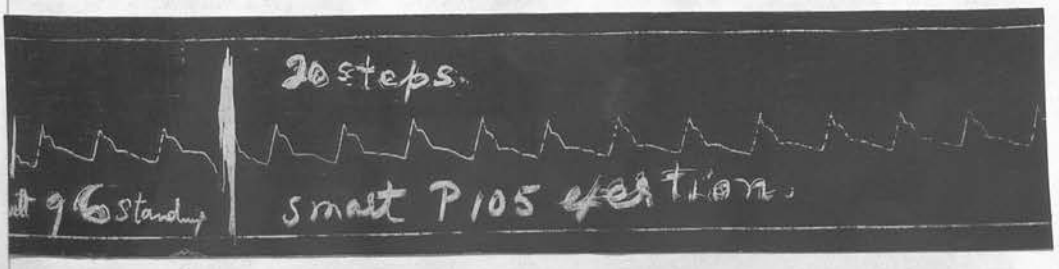


Fig 65. Male, age 78. Suffers from Bronchitis and slight œdema of the ankles. One or two "intermissions" occured in the pulse but none were reproduced on exertion.

66

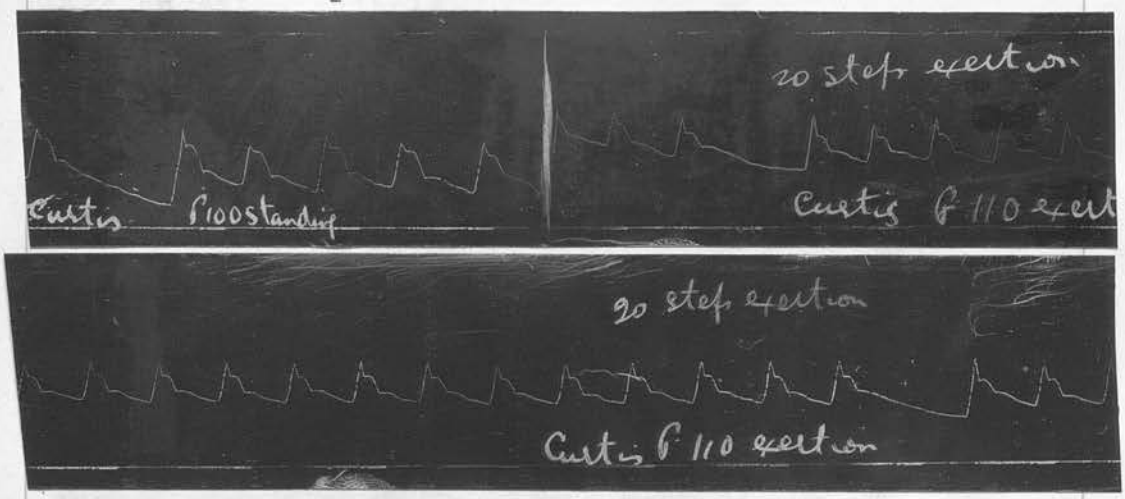


Fig 66. Male age 70. Bronchitis. Three months ago he had Cardiac dilatation with oedema of the ankles, but his condition is now greatly improved. On exertion he suffered from very considerable dyspnoea, but the pulse tracing shows a well maintained circulation, so that in all probability the Myocardium is in fairly good condition and the dyspnoea is due to his emphysema. Two "intermissions" occur on exertion, but just as many occur in the normal pulse ~~at~~ if there is a tendency to the development of 'Pulsus Alternans' after the long pause after exertion, that tendency will also be seen to occur in the pulse taken while standing.

The next two tracings were taken from Neurotic females and show the development of irregularity after exertion. They were subject to the sensation"as if the Heart had stopped" and to palpitation. This challenges the statement that exertion always makes irregularities due to Neurotic troubles, disappear.

67.

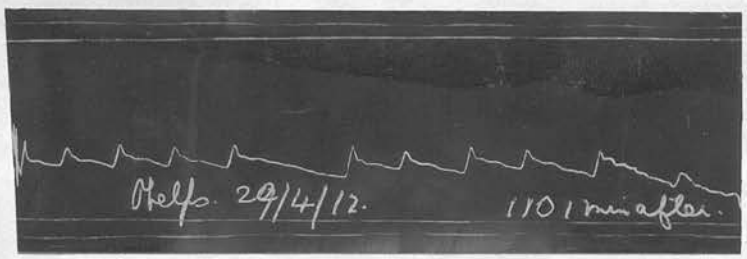


Fig 67. Female, age 28. Note the irregularities and the variations in the systoles found 1 minute after exertion.

68

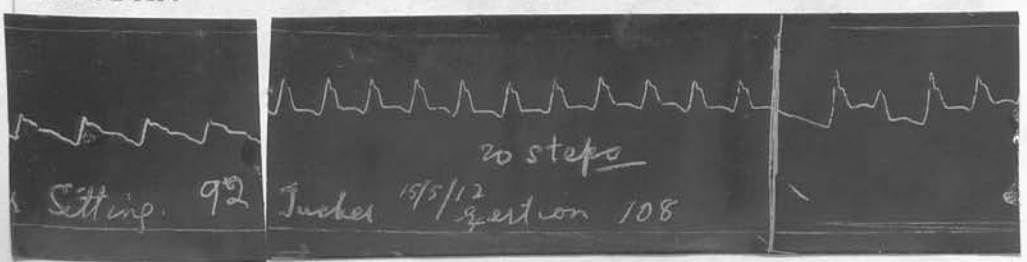


Fig 68. Female, age 27. Suffers from anaemia. On exertion the pressure varies and after the long pause there is an ordinary contraction followed by what looks like an extra systole.

It seems to be generally conceded that when the Circulation is inadequate there is a tendency to irregularity of the pulse on exertion. The following tracings are examples of irregularity induced by exertion, and where irregularity was already present it became more extreme. In many cases there was a tendency to the formation of an increased number of small 'linked beats' and some cases seemed to approach to the development of a condition somewhat resembling Paroxysmal Tachycardia.

69.

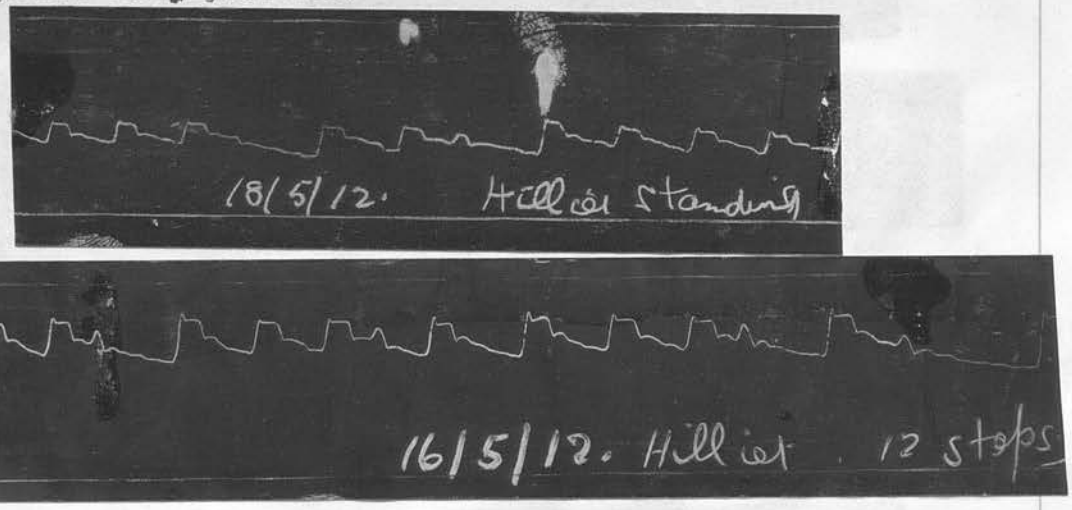


Fig 69. Male, age 86. (P. standing 78.
(Systolic Press: 180.
He suffers from Bronchitis, but has Cardiac dilatation with oedema of the ankles. Apex 4 inches from the mid line. On exertion irregularities develop, but they are not many and irregularities are also found in the ordinary pulse. The pressure is well maintained.

70

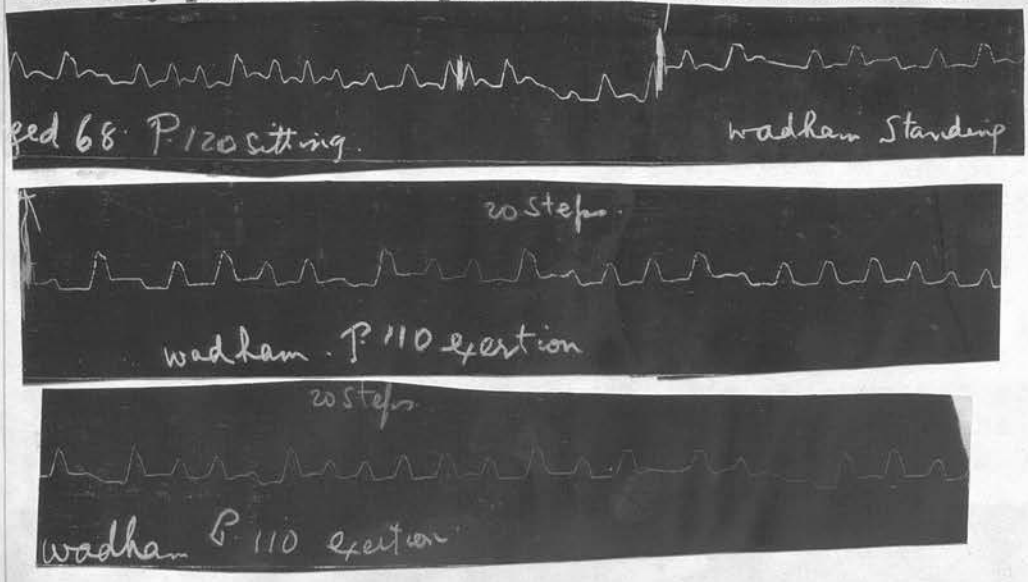
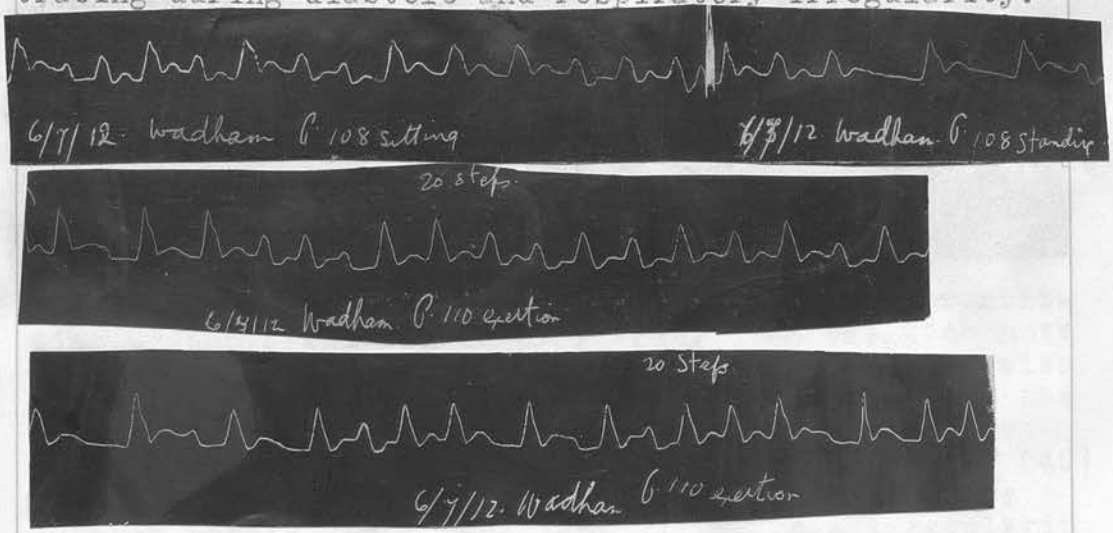


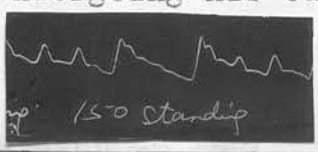
Fig 70. Male, age 68. This patient had a Cardiac breakdown 3 months ago but improved under treatment and he now again complains of Dyspnoea. He has a grossly

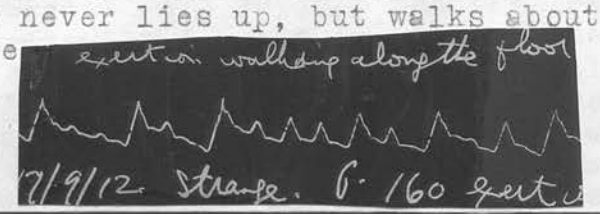
irregular pulse, Cardiac dilatation, mitral systolic murmur and œdema of the ankles. Note the great irregularity of the pulse, and on exertion it will be seen that the Heart contracts powerfully and that the rate of the pulse is reduced. There isflattening of the tracing during diastole and respiratory irregularity.



71

Fig 71. was taken from the same patient a week later after he had had m.x of the Tincture of Digitalis, three times a day. The arteries are better filled during diastole. There is a slight tendency to hyperdicrotism; but exertion seems to have little effect on his heart and the patient is one who never lies up, but walks about while undergoing his cure.





72

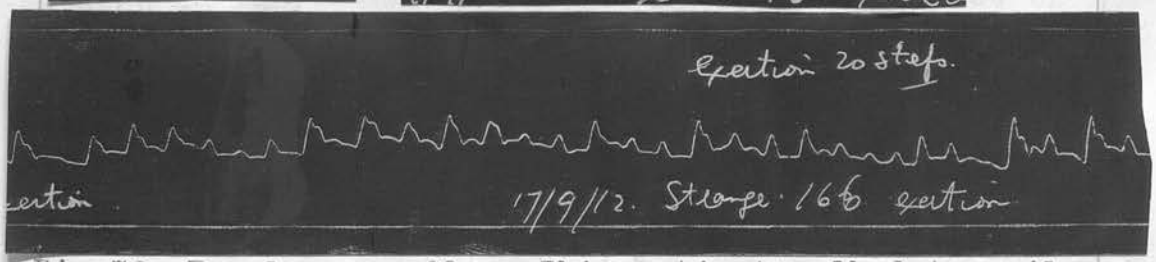
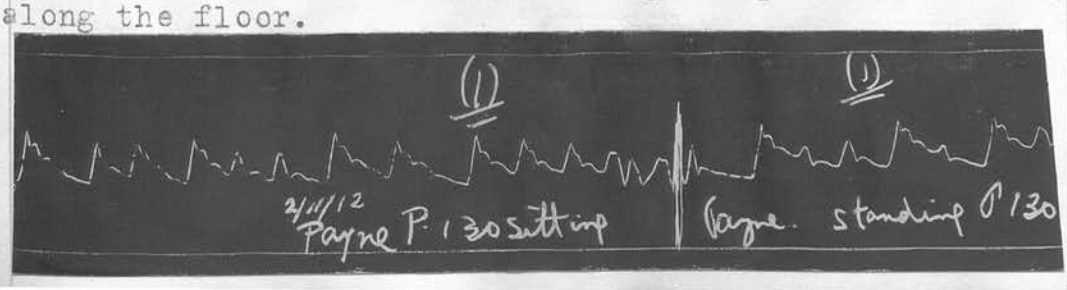


Fig 72. Female, age 69. This patient walked two miles to the Dispensary. She gets Bronchitis and wheezing from time to time. The Cardiac apex is $4\frac{3}{4}$ inches from the mid line: the pulsation is forcible: there is no murmur but the ankles swell especially at night. On exertion the pulse becomes very irregular and there is the tendency to the development of a great number of small contractions. When the effects of exertion are beginning to pass off stronger beats develop and the same result was obtained by making the patient walk along the floor.

73.



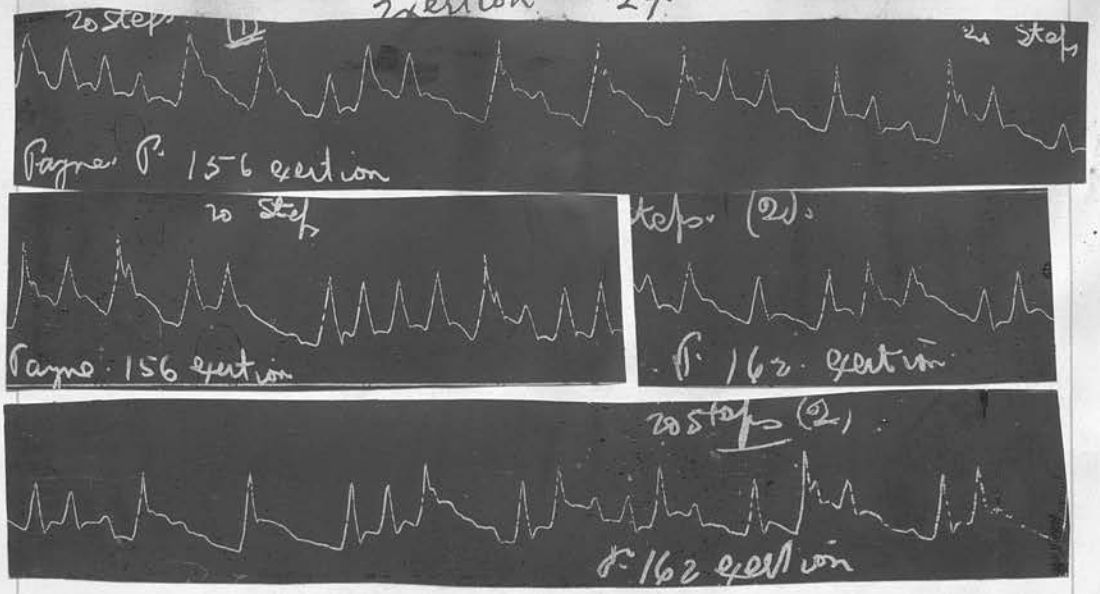


Fig 73. Female, age 68. Cardiac dilatation: Bronchitis: Cyanosis and oedema of ankles. On exertion note the relatively large Ventricular contractions and also the extra systoles which vary in size. Note also the occasional sequence of beats of low tension after a long pause. The Rhythm is nondescript. McKenzie (40) discribes similar cases thus: "In patients who have exerted themselves a transient but extreme irregularity may be detected in the pulse; small beats and big beats may follow one another in bewildering fashion. But so brief is the duration of the tumuotuous action of the pulse that before one can apply a Sphygmograph the arrhythmia has to a great extent disappeared" In my observation I have found that the changes in the pulse due to exertion subside very rapidly, and the loss of a few seconds would greatly detract from the value of the tracing.. The lowering of the pressure following exert exertion brings out a similarity in this case to one shown by Russell (18) to demonstrate the effects of Erythro-tetranitrate where the ordinary pulse may be taken to represent the pulse before, and the pulse on exertion that after the administration of the Nitrite.

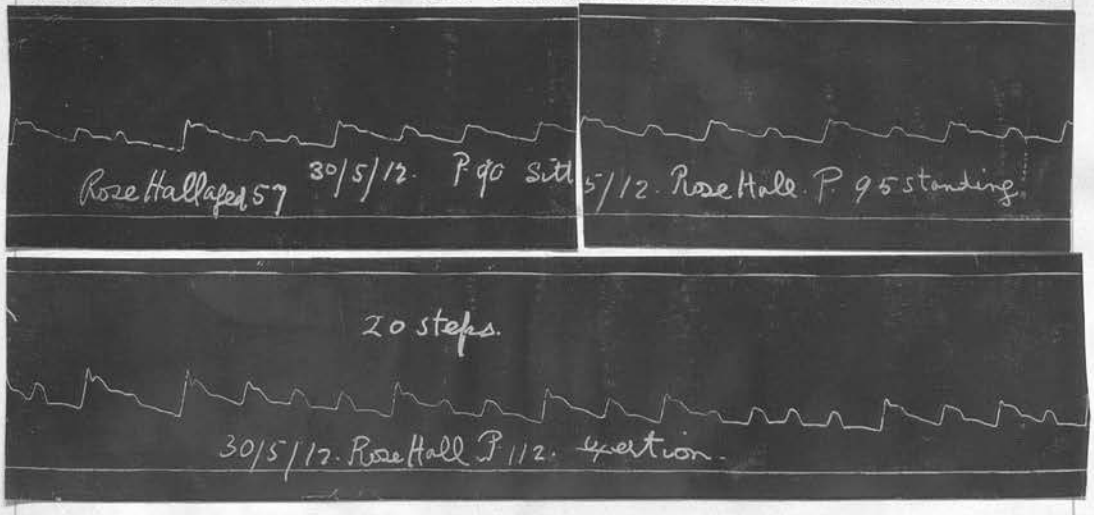


Fig 74. Female, age 57. This patient walked in to the Dispensary and had a Mitral systolic murmur. The Cardiac apex did not extend beyond the nipple. Her cardiac condition was due to Rheumatic fever 14 years ago. It will be seen that, while on sitting and standing

there are one or two small contractions after each full beat, on exertion we get one full beat with 3-4 smaller ones. The arterial tension is however well maintained and she was not breathless on exertion; her condition improving with Cardiac Tonics and without rest in bed. The result of exertion in more severe cases would be that the small contractions would be too feeble to affect the pulse at the wrist and the tracing would show a line with an occasional summit.

75

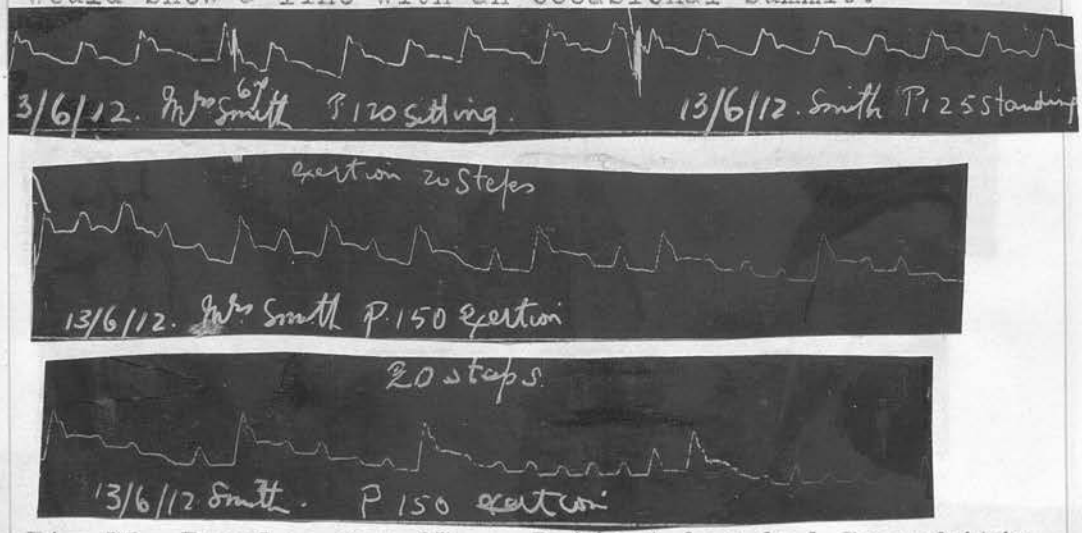


Fig 75. Female. age 67. Patient has had Bronchitis every Winter for 12 years. She has an Emphysematous chest; cardiac apex 4¼ inches from the mid line; dilatation of the Heart and a mitral systolic murmur. There were about 5-10 "intermissions" per minute in the ordinary pulse, though the tracing shows no more than a slight inequality, but on exertion a marked change will be seen to occur. At first one extra systole occurs after every full beat and gradually this increases till we get, 2, 3, 4, 5, 6, and 7 after each full beat and finally some of the smaller contractions are no longer on the decending line of the last contraction, but are on the base line — (independent?)

76

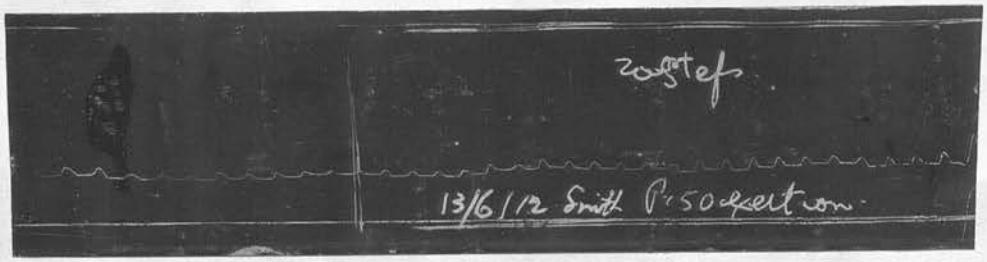


Fig 76. was obtained from her pulse the first time she mounted the stairs, but as I thought the condition might have been due to the Sphygmograph's slipping off the wrist, I made her remount, and got tracing 75. On ~~exertion~~ examination however it will be seen that fig 76 shows a much faster pulse of about 180+, and taking into account the almost independent nature of the small waves towards the end of tracing number 75, I am inclined

to think that fig 76 may represent a form of "Paroxysmal Tachycardia" induced in this patient by exertion. McKenzie (36) believes, that "Paroxysmal Tachycardia" may be due to a series of premature systoles" in this case there is a tendency to the substitution of small premature contractions for the ordinary systoles.

77

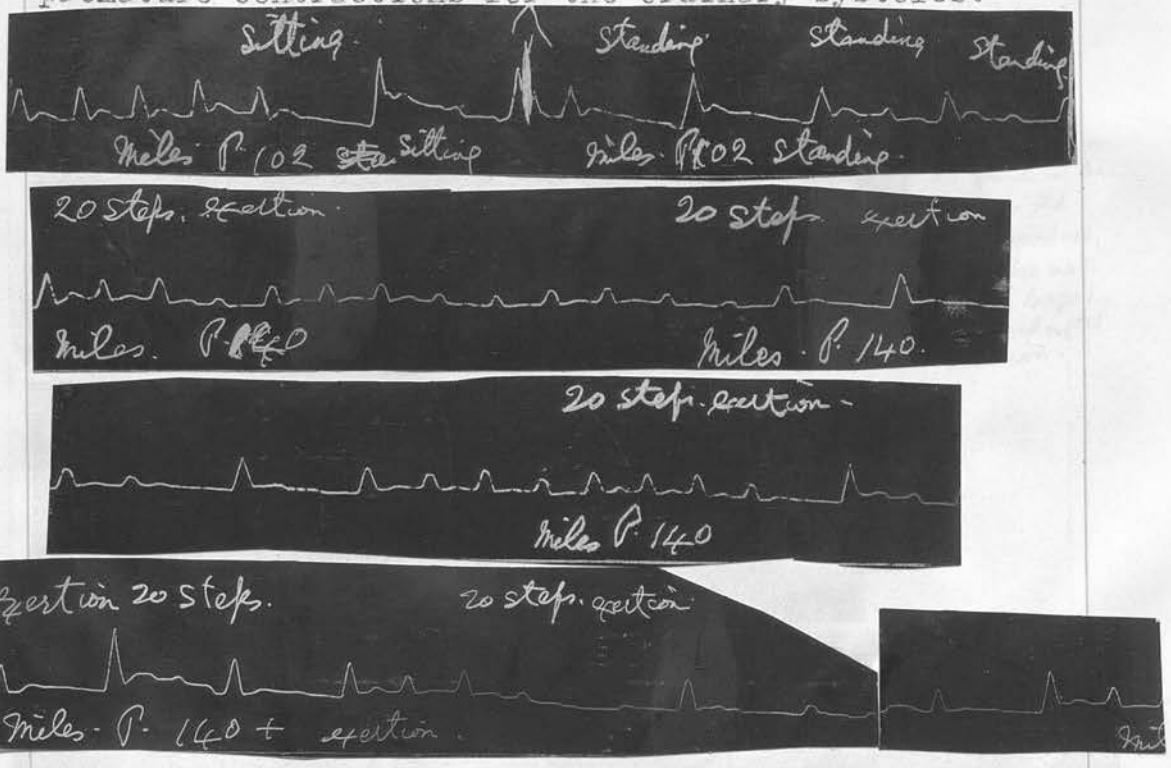


Fig 77. Male, age 56. Cardiac dilatation, with mitral systolic murmur; venous congestion of face and venules round the costal margins: enlarged liver and oedema of the legs. On exertion his chief complaint was giddiness, but he was also very breathless. On exertion it will be seen that there is a disappearance of the strong contractions found on sitting and standing, their place being taken by small rounded summits occasionally appearing along what would otherwise be a straight line, and in some portions it will be noticed that for quite long periods there are intervals of silence during which the cardiac contractions fail to affect the pulse at the wrist. In contradistinction to this case note the next ~~case~~ where the Heart responds better to exertion.

78.

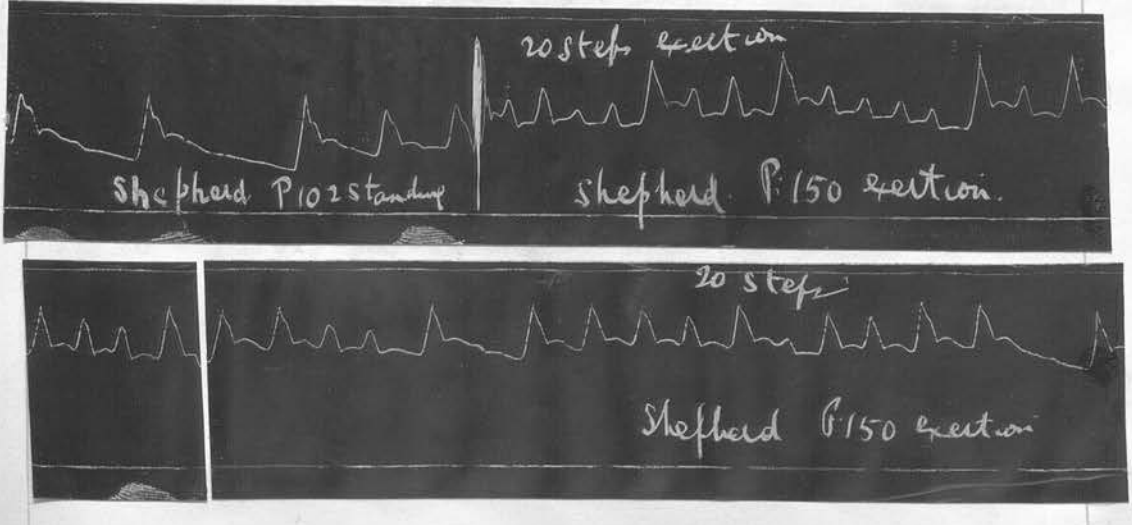
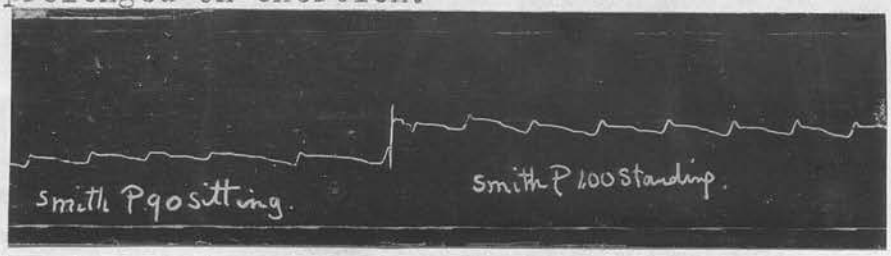
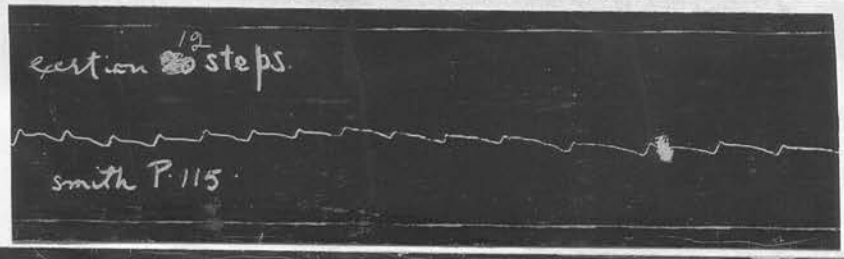


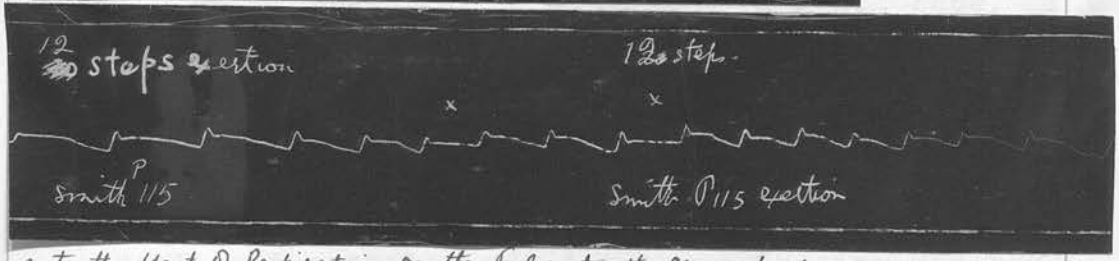
Fig 78. Male, age 60. This patient is convalescent from a cardiac breakdown 3 months ago, when he had oedema of the legs and the other signs of Heart failure. On exertion in this case it will be seen that there is a tendency to the development of small contractions on the descending line in place of the long pauses found on standing. This case one would think reacts fairly well to exertion and differs from the last case (fig 77) were the long pauses tended to become more prolonged on exertion.



large contractions are found in the pulse in the sitting posture, but they are not quite so large as those found after exertion.

79.



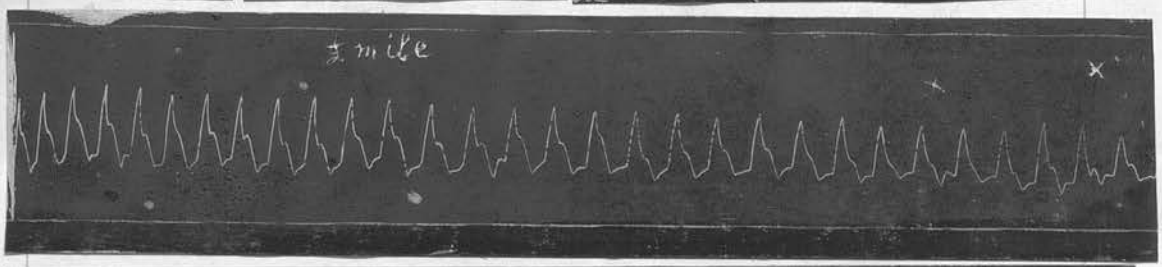


note the effect of Respiration on the Pulse at the crossed areas.

Fig 79. Female, age 7. The history in this case was that she gets blue on exertion, and that she had attacks of Haemoptysis. On examination I found that she had cyanosis of cheeks: rather massive oedema of the legs, and a presystolic Mitral murmur. The pulse was very small and it was dificult to get a good trace as the child fidgeted so much. The most noteworthy fact was the tremendous effect respiration had on her ordinary pulse, and on exertion the effect was very much greater. It will be seen how this causes the rate to vary so much from time to time. Note the 3 large contractions ~~also occur, but they are not so large as on exertion~~ at the beginning of the last tracing. In many of the above cases it might seem, that the tests should not have been used, but all the patients walked into the Dispensary, not one of them objected to the test, and as a rule they had to climb stairs twice as high and as difficult at home. We shall now leave the Pathological section and turn to a purely physiological region.

(1)

(2)



80

(3)

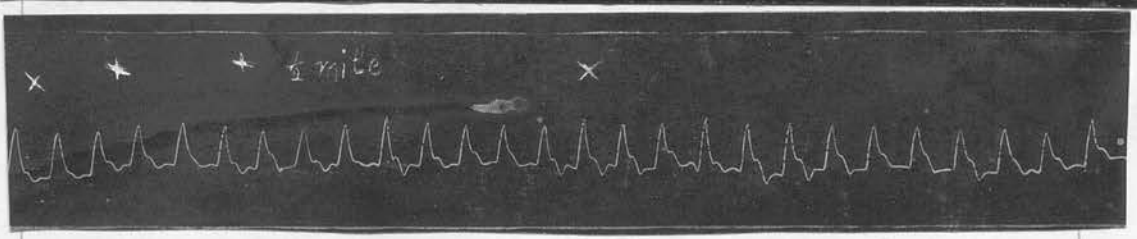


Fig 80. was taken from a healthy youth aged 18 years. The first tracing shows the condition of his pulse after ordinary exertion, and the 2nd. and 3rd. tracings give a continuous picture of the effects produced on the pulse by running half a mile at a quick pace. The Sphygmograph was applied to the wrist but at the end of a quarter mile it was found that the instrument had slipped round slightly. It was again adjusted and on the completion of another quarter of a mile the instrument was in good position and wanted very slight attention. The smoked paper was now slipped in and the subject was made to run 100 yards at a good pace to keep up the effort, and the above tracing was taken immediately on his arrival. The points to be noted are the lowness of the diastolic pressure, and the variations in form and fullness of the pulse with each pulse wave. After a quick systole the artery is apparently fairly empty during diastole. The first few beats are practically monocrotic giving an indication of what may possibly take place during exertion. Towards the end of the tracing will be found waves similar to those described by Ewart (41) when the effects of Amyl Nitrite were beginning to pass off. Some of those I have marked by a cross and I have found them when the pressure conditions are varying as the effects of exertion are beginning to pass off. The actual pulse rate is not given as this varies so considerably. Cleghorn (27) and other American observers have succeeded in taking pulse tracings of Marathon runners, two minutes after the completion of the race, but on examination of the above tracing, it will be evident that the delay of a few seconds would have lost the most valuable part of the tracing, as the pulse so speedily regains its usual character. Allbutt (13) thinks that 'Pulsus Alternans' may be produced by exertion and certainly the pulsations vary greatly, but though the variation is occasionally restricted to alternate beats, it is generally more irregular in incidence.

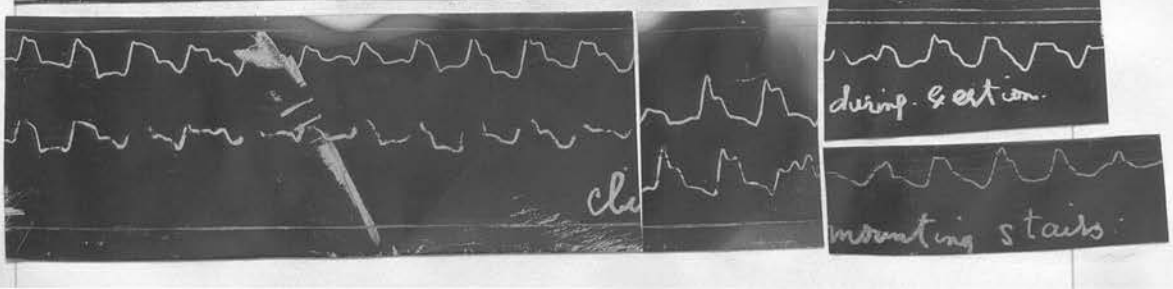
Larrabee (27) says "it is almost certain that there is a marked drop in the blood pressure of the Marathon runners after a race" and Cleghorn's tracing pointed to enormously low arterial tension with dicrotism, and in two-thirds of the cases the pulse was markedly irregular. Keyt (42) took tracings from the pulse of Bertha von Hillern during intervals in her walk of 100 miles in 28 hours, and the tracing taken 10 minutes after the completion of the 98th. mile shows a small tracing, sloping, without mark of Predicrotic wave and distinctly dicrotic, pointing to diminished arterial tension. Williams(26) found the pulse of exceedingly low tension after a Marathon race. The tracings taken by Schott (29) after 10 minutes wrestling show pulses of very low and varying tension and the blood pressure at the end of the 10 minutes had fallen from 115-82mm. Oertel (30) found that exertion raised the blood pressure but produced a Sphygmogram typical of a low tension pulse. Mahomed (32) says that exertion has the effect of increasing the rapidity of the pulse and of diminishing the tidal wave, and with reference to fever Sansom (33) says that "in early fever the exaggerated Heart force may cause a greater volume than normal of blood to be expelled at each systole. Therefore the arterial tension will be increased though the tracings don't look like it." Christ quoted by Hill (8) says that the exertion of climbing steps may produce marked dicrotism.

These authors all seem to find that however the blood pressure may be raised, the effect of exertion is to generate a pulse known in Sphygmographic language as a low tension pulse, and the observations I have made bring me to the same conclusion. In other words the blood pressure may or may not be raised by exertion but many changes ~~are~~ are effected in the "Balance of the Circulation' which are best shown up by the Sphygmograph.

81

A

B



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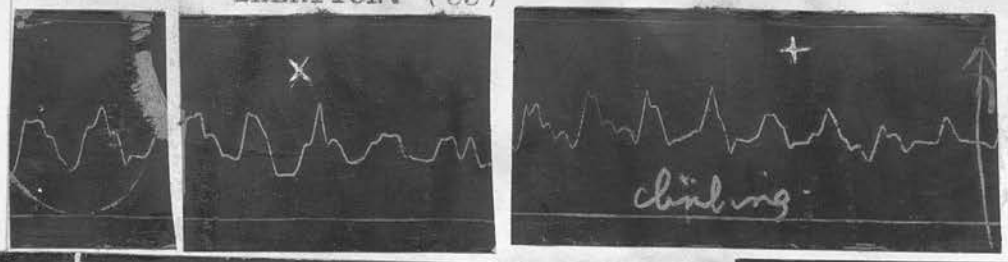
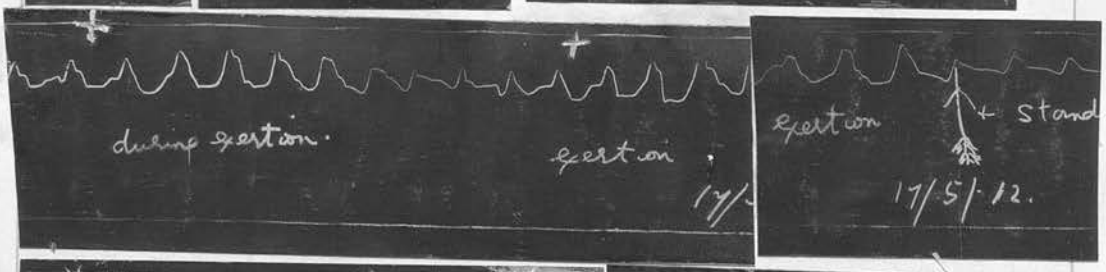
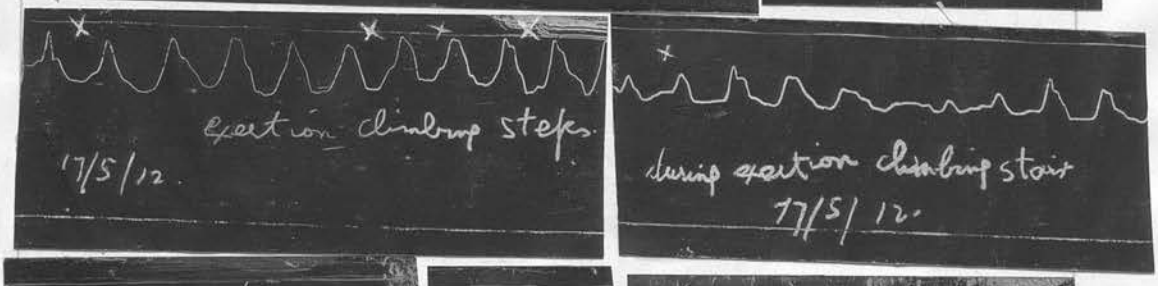
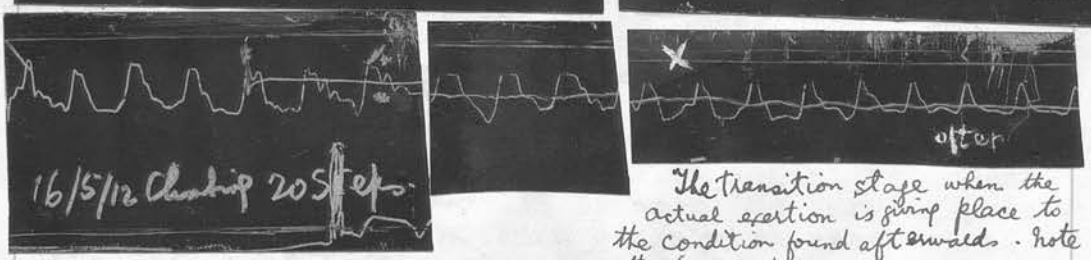




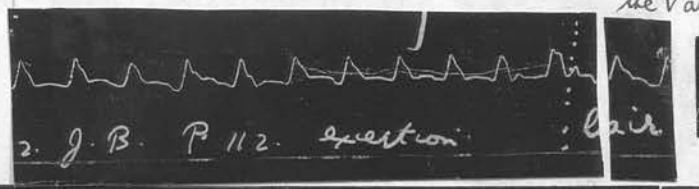


(c)



The transition stage when the actual exertion is giving place to the condition found afterwards. Note the varying pressures.

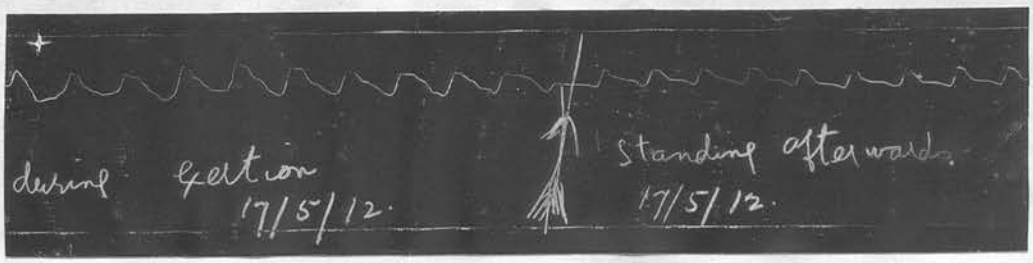
C



also exemplifies varying pressure.

81 C

(D.)



The pulse is apparently slower during than after exertion in this case.

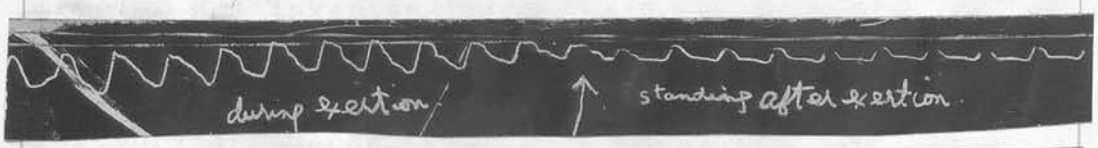


Fig 81 represents an attempt made to register the pulse during exertion. Fig (A) was taken in the ordinary way after exertion, but the others were taken during exertion, and in some cases will be seen a continuous tracing of the pulse during and after exertion. To limit the amount of oscillation a small piece of wood was attached to the writing lever and though the resulting tracings are poor, still they may help to give some indications of the conditions obtained during exertion. Fig 80 showed us that the diastolic pressure is very variable and that factor is confirmed by these tracings. The indications are that exertion produces high pressure during systole and low pressure during diastole; but the pressure during systole seems to be maintained for a longer period than might have been expected. Though we get a lowered pulse tension after exertion, in one of the tracings fig (B) it will be noted that the first 2-3 contractions after exertion represent a higher tension than that found in the subsequent ones; indicating that the tension found during exertion is probably higher than that found on its completion. Under ordinary conditions it would be impossible to get near enough to these conditions to determine this point and my best tracings after exertion probably got no nearer than the 6th. beat and by that time it will be seen that the pulse tension has been reduced. This tracing is a good example of the rapid changes undergone by the pulse from moment to moment. In other cases fig (C) will be seen the varying pressures found in the transition stage when exertion is being replaced by the standing afterwards. A cross marks the hyperdicrotic portions and in some cases there is a tendency to the developement of the monocrotic beat. On measuring such tracings as fig (D) it will be seen that the pulse during exertion is generally as slow or slower than that found afterwards. The writing lever was too heavily weighted to give a proper tracing under ordinary conditions, but the extra oscillation induced by exertion has been to a certain extent regulated.

82.

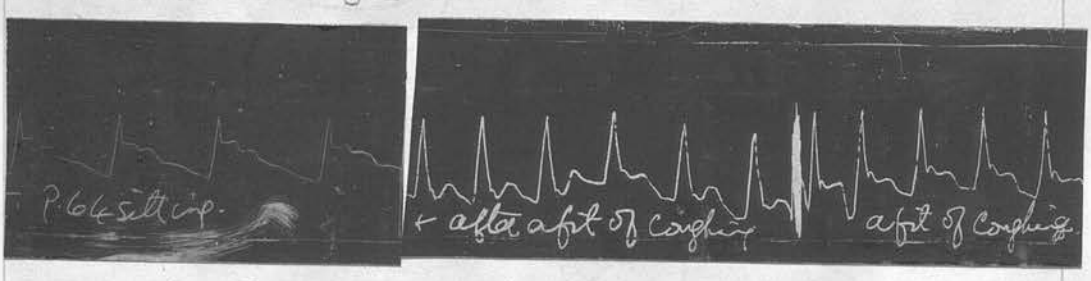
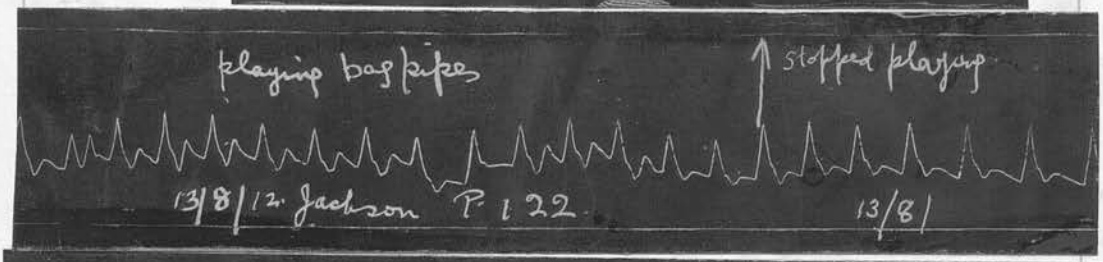


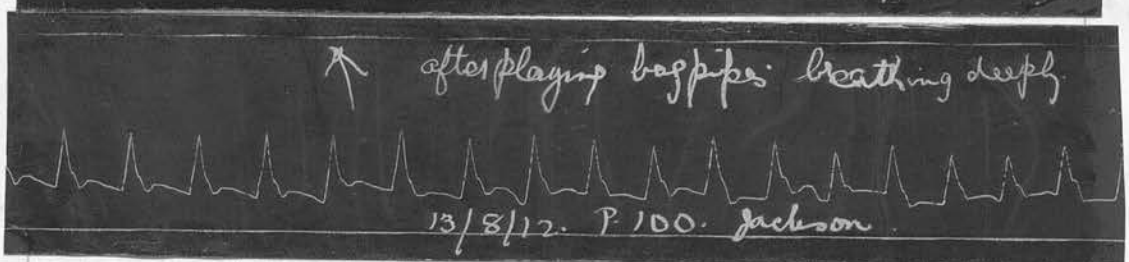
Fig 82 was taken from a male aged 29. The ordinary tracing was taken, and with the Sphygmograph still on the wrist a paroxysmal fit of coughing took place, with the result shown. It will be seen that there is a great lowering of pulse tension and a profound respiratory influence. He had a large and full pulse, with a Systolic Blood pressure of 140, but though the pulse is markedly influenced by the cough, a similarly

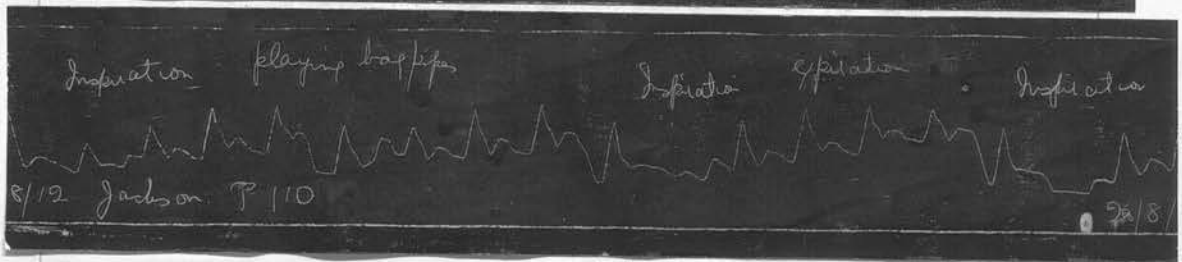
intense cough would have had little change on the pulse of the aged.

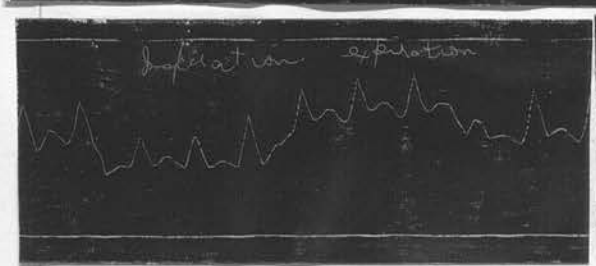
83.

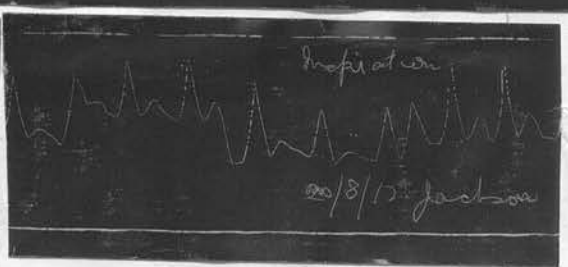
Ordinary pulse before playing the pipes.

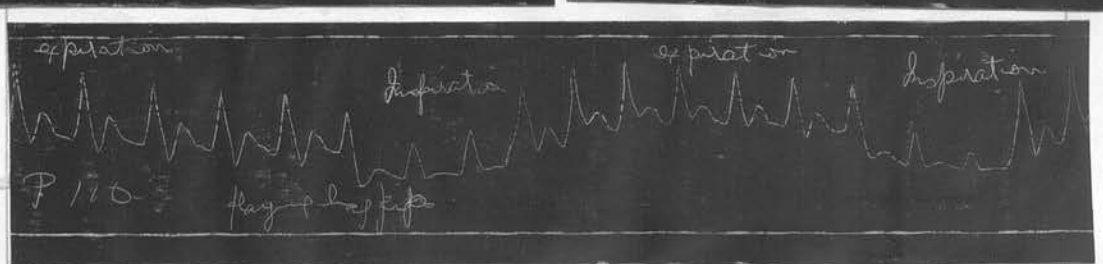


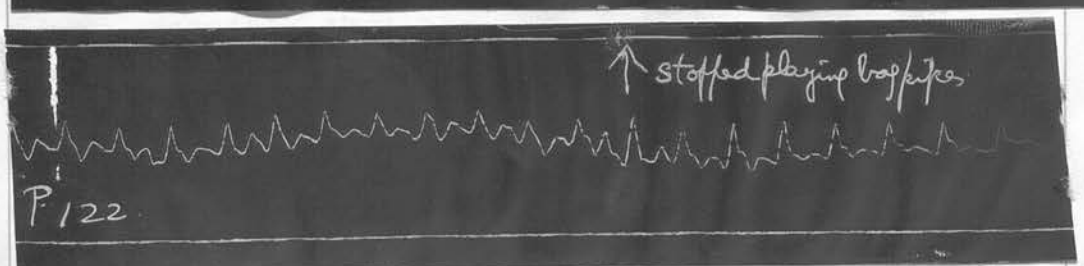












Note the speedy readjustment of pressure at the end of play. I have been greatly impressed by the elasticity of the circulation.

Fig 83. shows the changes induced in the pulse of a boy aged 17 through playing the Bagpipes. The pipes were kept going during the observation, one hand manipulating the Chanter while the other was kept as steady as possible during the taking of the tracing. the pulse is very fast and hyperdicrotic, and during deep Inspiration a partial 'Pulsus Paradoxus' develops, the pulse being of lower tension than during expiration.

Many writers have wondered why, if there is general dilatation of the arterioles, exertion should lead to Heart strain and dilatation. To all appearances the work of the Heart should be easier and Gibson (11) thinks that the circulation of waste products may have a deleterious effect and may render the circulation of blood through the tissues more difficult. But though there is a general dilatation of the arterioles this may not affect the aorta to a great extent and at each systole the Heart may still have to exert a considerable amount of energy in dilating the aorta. Tigerstedt quoted by Janeway (1) has shown that not more than 1/160th. of the work of the Heart is expended in imparting to the blood stream its velocity, the entire remainder being required to overcome aortic pressure. Conditions undoubtedly change on exertion, but the dilatation of the aorta by the blood expelled from the Heart at each systole, must still account for a large expenditure of energy.

CONCLUSIONS.

(1). That exertion under ordinary conditions seems to raise blood pressure; but lower blood tension as demonstrated by the Sphygmograph.

(2). That the most important condition is the 'Balance of the Circulation'.

(3). That after severe exertion marked lowering of the diastolic pressure occurs and great variation in individual systolic contractions. It is probable however that the tension of the pulse during exertion is higher than that immediately after, and I have shown some cases which pointed in that direction. It is also possible that the pulse may be of monocrotic variety occasionally during exertion.

(4). That the characters of the pulse after exertion change with great rapidity.

(5). That exertion, in Cardiac cases induces irregularity in Rate and Rhythm, great respiratory irregularity and undulation, and an empty condition of the arteries during diastole.

(6). McKenzie says that the main symptoms on exertion in Cardiac cases are subjective and apart from breathlessness the main symptom complained of seems to be giddiness.

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III

The Effect of Food & the Processes of Digestion on the Circulation.

III THE EFFECT OF FOOD AND THE PROCESSES OF DIGESTION ON THE CIRCULATION.

A considerable amount of doubt still remains as to the effect produced on the Circulation by the ingestion of food and the processes of digestion; but the fact is undoubted that exertion after meals has often induced sudden death in patients whose Hearts were diseased. Various explanations have been brought forward to account for this, and the one usually given is that the stomach, distended with ~~the~~ food and flatus pushes up the Diaphragm and impedes the action of the Heart. This undoubtedly happens and must be a serious encumbrance to a diseased Heart, but I think there is another possible explanation. Authors differ as to the influence meals have on the Blood pressure, but more important to my mind than any pressure variation, is the fact that the "Balance of the Circulation" is upset and a pulse full and splashing and resembling a collapsing pulse is produced.

In studying the effect of posture on the Circulation, I found that in some cases a great fall of diastolic pressure occurred immediately on standing, and that this fall of pressure coincided with the "feeling of blackness" and of giddiness that occasionally seizes people on standing up suddenly. Digestion accentuates the tendency to this collapsing condition of pulse and though this might be of small moment in a healthy patient, it might be far otherwise in a patient with Heart disease. This state of affairs is apt to be exaggerated by exertion and the lowered tension accompanying ordinary exertion becomes lower still in exertion following a full meal.

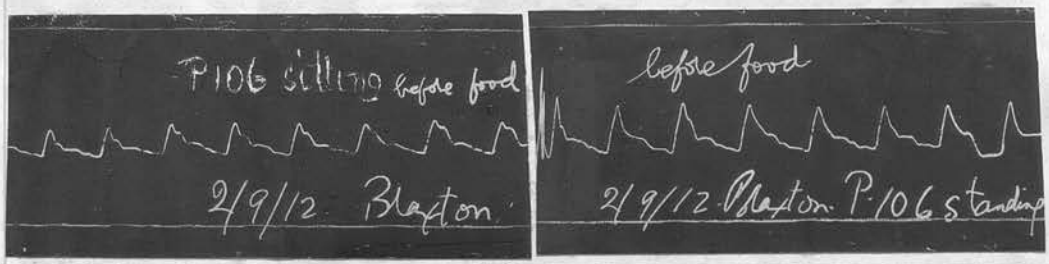
In some of my cases it will be seen that exertion produces pulse tracings resembling those shown by Bramwell and others and described by them as "showing an empty condition of the artery during diastole, often associated with a failing Heart."

Here are some opinions from various authorities. Colombo (1) finds a fall in diastolic pressure of 20mms. after meals and Janeway (2) thinks that systolic and diastolic pressures are equally affected; a rise of 5mm. Systolic occurring with a fall of 5mm. diastolic pressure. Goldwater (3) believes that meals cause a rise of pressure. Broadbent (4) says "Food accelerates the Heart's action and relaxes the peripheral vessels. The arteries are relaxed and large and the tension is thus lowered after meals." Oliver (5) thinks that there is a great dilatation in the Splanchnic area and compensatory contraction of the cutaneous vessels. He also says (6) that digestion causes a rise of Blood pressure in the distal area (terminal phalanx of finger),

usually associated with a fall in the Brachio-Radial pressure, and believes that the Hypotonic effect of digestion is quite usual in the earlier half of life and the Hypertonic in the later half. Hirschfelder (7) says that after meals the maximal and pulse pressures are increased and also the minimal pressure but to a lesser extent. According to him meals, exercise etc. produce a pulse with marked peripheral dilatation and of collapsing type with large dicrotic wave. Erlanger and Hooker (8) state that an increase in pulse pressure becomes manifest within a few minutes after the beginning of the meal. Gibson (9) says "The influence of food is somewhat variable, sometimes a rise of pressure is found after a meal, but almost as frequently there is a fall. Bramwell (10) explains the effects thus - "The dyspnoea which Cardiac patients so frequently experience after a full meal, when the stomach becomes distended with flatus, during attacks of dyspepsia etc. .... seems in some cases to be produced by reflex impressions passing from the stomach through the Vagus nerve to the Heart."

In my cases the postural variations before and after meals are first compared and then the effects induced by exertion, and the effects of exertion are examined in the manner explained in Section II.

(1)



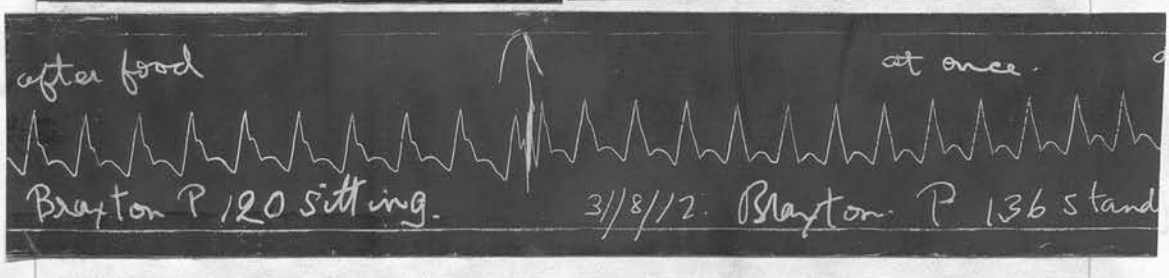


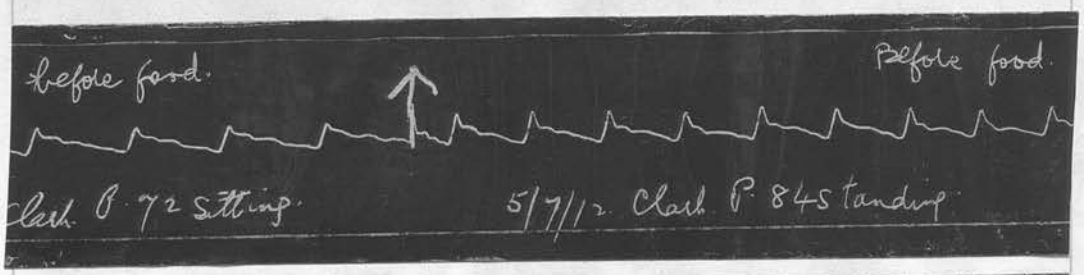
Fig 1. Female, age 34; convalescent after an attack of Tonsilitis which has left her very debilitated. She suffered from palpitation after meals.

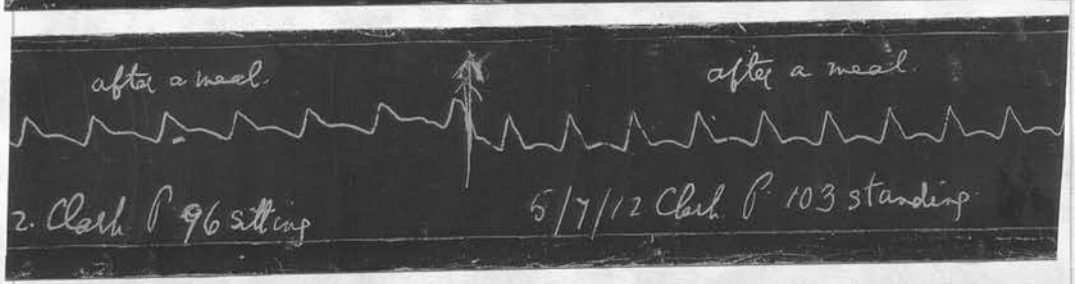
Before Food.		Before Food.	
(P. sitting	106	(P. standing	106
(Systolic pressure	135	(Syst. Press.	145
(Diastolic "	90	(Diast. "	90

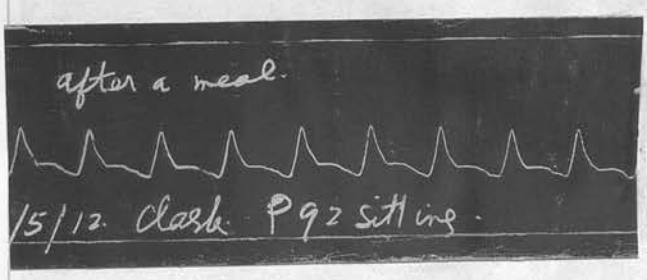
After Food.		After Food.	
(P. sitt.	120	(P. stand.	126
(Syst. Press.	150	(Syst. Press.	145
(Diast. "	90	(Diast. "	90

In this case it will be noted that there is a more immediate fall of pressure on standing after food than before. The rate is also greatly accelerated. Note the gradual return of pressure after standing for 2 minutes.

12







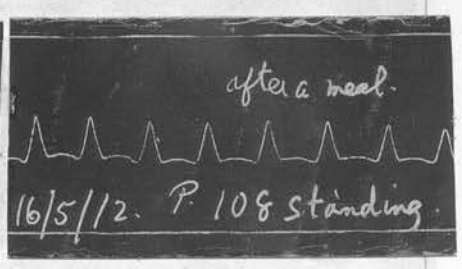


Fig 2. Male, age 29.

(P. sitting before food	72	(Pulse sitting after food	96
(Systolic Press.	130	(Systolic Pressure	135
(Diast. "	95	(Diastolic "	90

After food the pulse was much softer and the fall of pressure on standing is more marked. The increase of rate on standing may be no greater than before meals, but the collapsing nature of the pulse becomes more apparent.

3

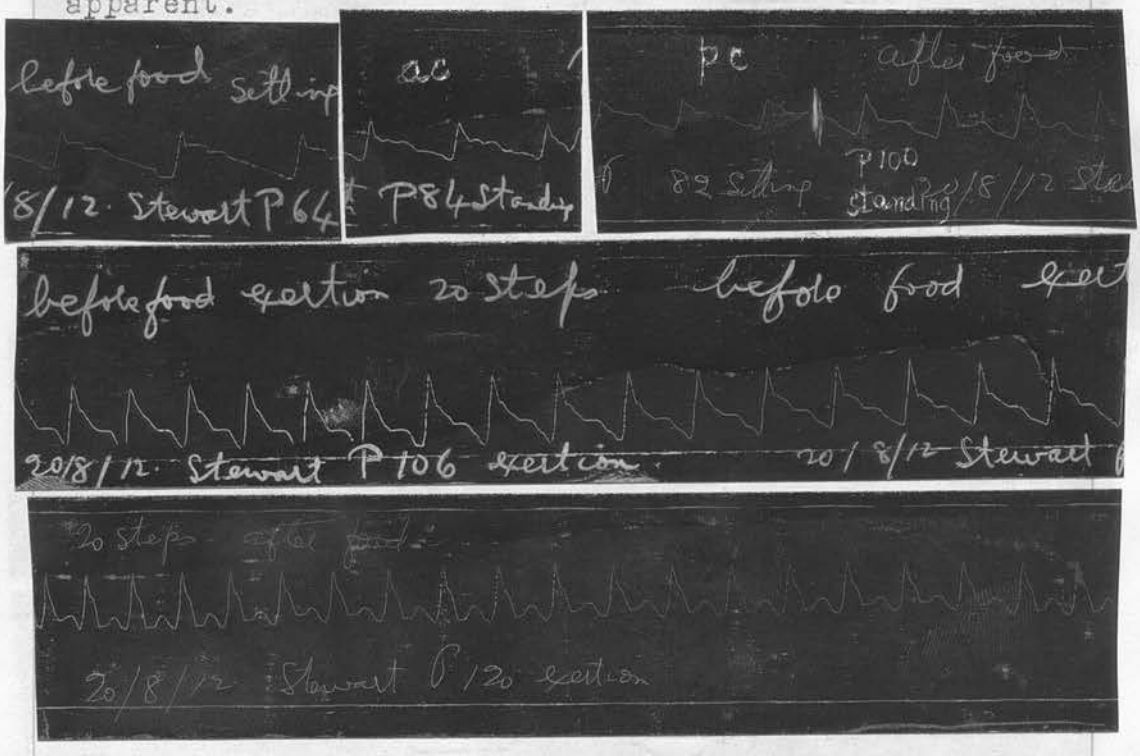


Fig 3. Female, age 25. Apart from the increased rate it will be seen that the pressure of the pulse on standing after meals is less sustained than that before meals. Exertion after meals also causes a considerable reduction in the tension and an increase of rate. The pulse also becomes dicrotous and Mc-Kenzie (12) thinks that patients with dicrotous pulses are short-winded on exertion.

4

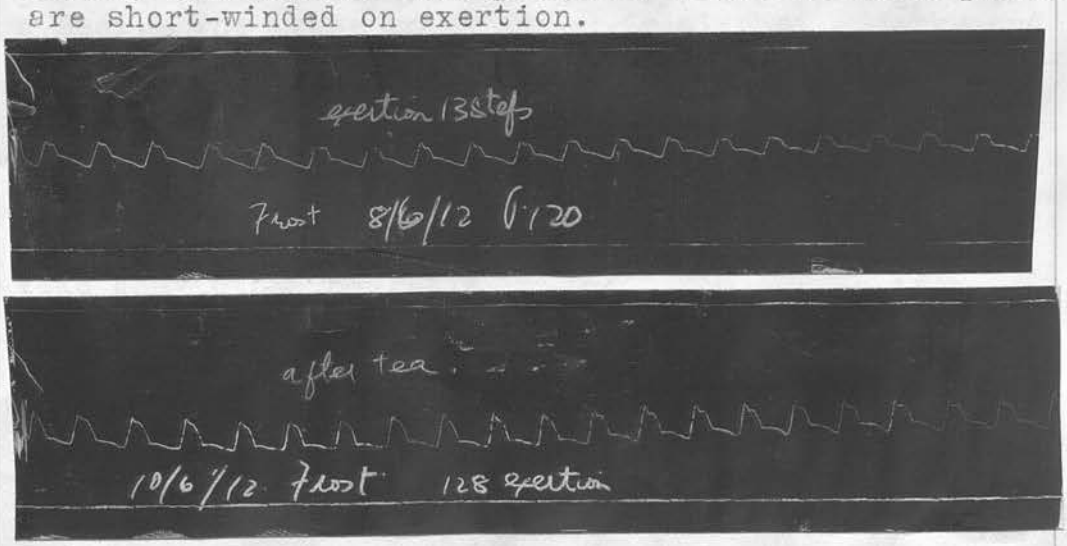


Fig 4. Female, age 39. Patient is anaemic and neurotic.

(P. sitting before food	86	(P. sitt. after food	81
(Systolic Pressure	140	(Systolic Pressure	135
(Diastolic "	90	(Diastolic "	85

On exertion after food it will be noted that although the Systole is apparently more powerful there is a greater fall in diastole.

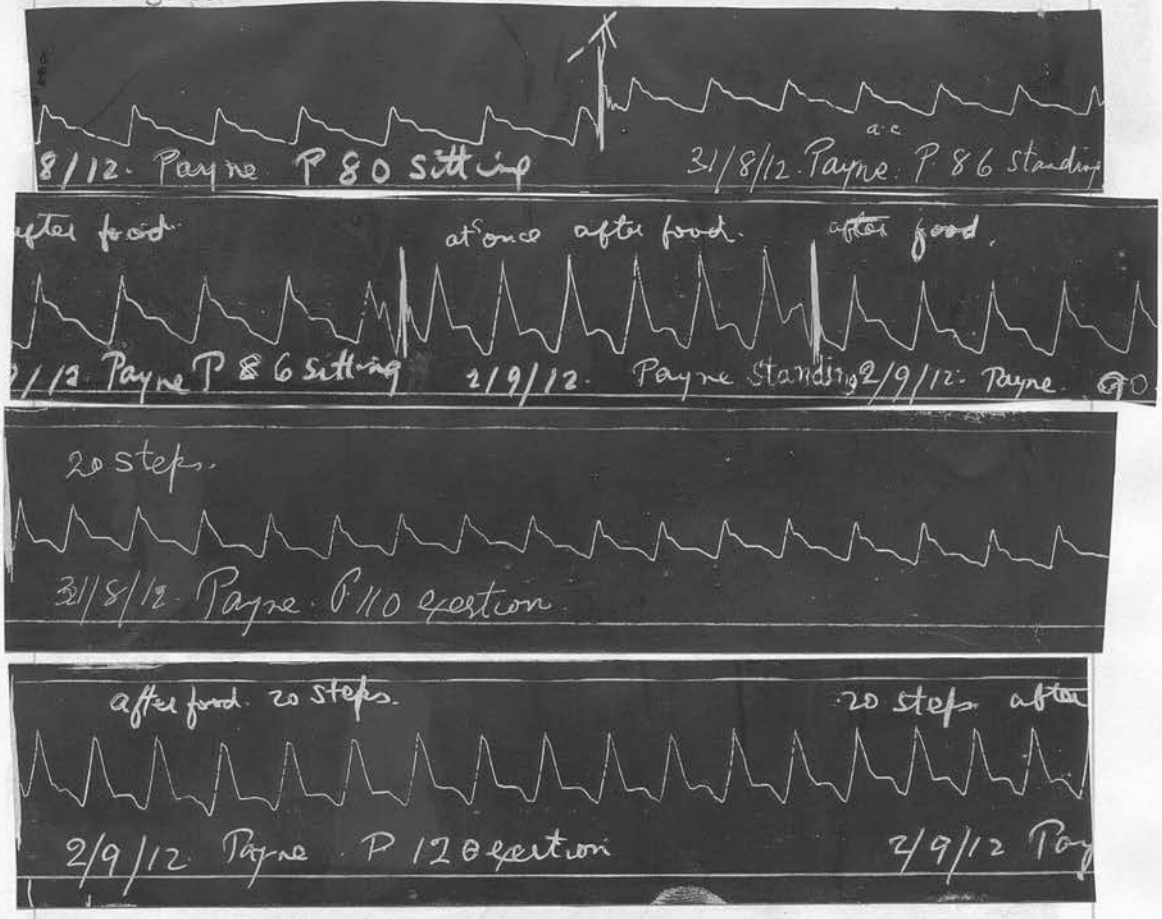
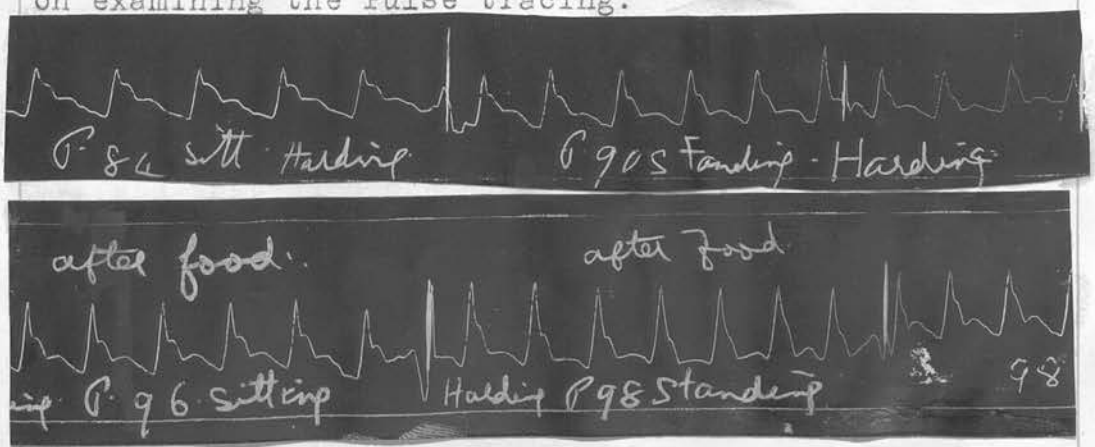


Fig 5. Female age 27. She suffers from palpitation after meals. The postural rate is not increased by meals, but it will be seen at once that there is a great fall of pressure immediately on standing after a meal. The pulse on exertion is also of a jerky and unsustained character and in her case meals had the effect of inducing a pulse somewhat resembling the collapsing pulse in cases of aortic Incompetence. This pulse also resembles fig (67) in Byron Bramwell's "Students' Guide to the Examination of the Pulse" representing "an empty condition of the artery during diastole; signifying a failing Heart". This patient like many other neurotic patients who suffer from Palpitation, complained of a certain degree of dyspnoea on exertion after meals. We need not wonder at that on examining the Pulse tracing.



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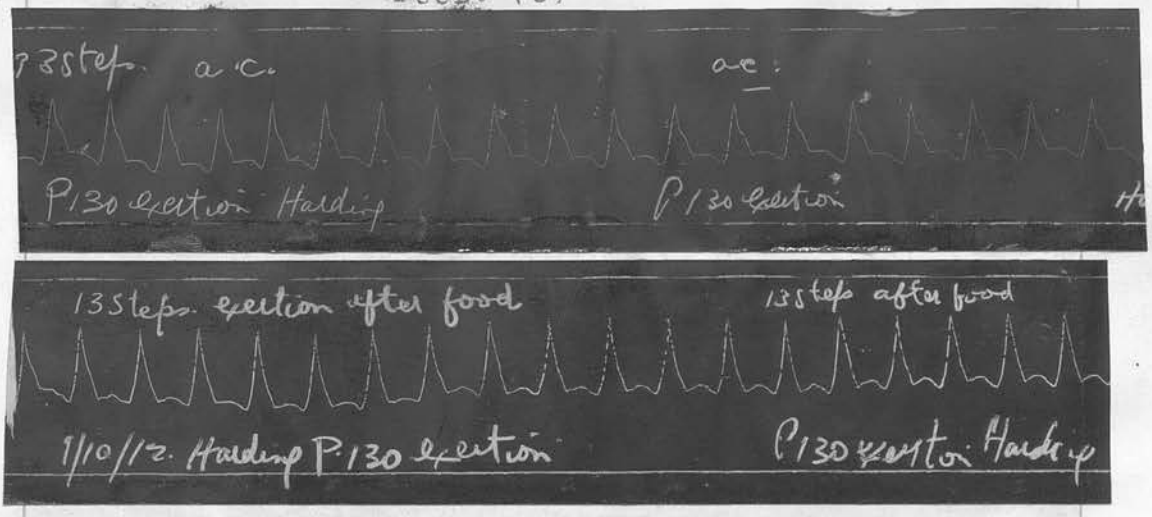
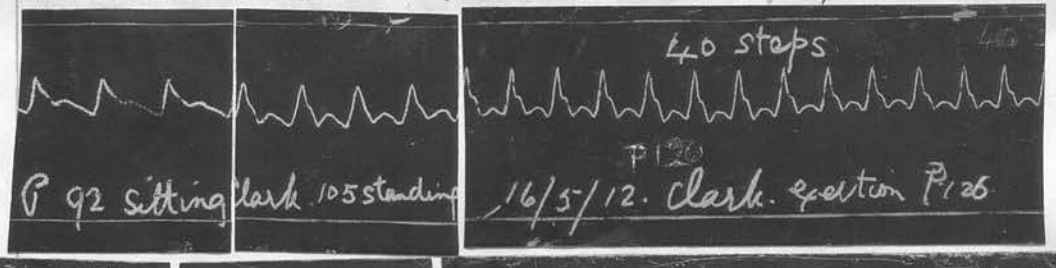


Fig 6. Female age 21. She was suffering from Anaemia and had Thyroid enlargement 3 weeks before, with Exophthalmos and Pulse of 120, pointing to a mild form of Exophthalmic Goitre. Most of the symptoms had settled down by the time of examination. The postural rate is not increased by the meal but it will be noticed that the fall of pressure immediately on standing is much greater than before. On exertion the diastolic portion of the trace is flatter and falls lower down, and there is less sign of a predicrotic wave than in the tracing taken before food. greater suddenness of the pulse.

7.



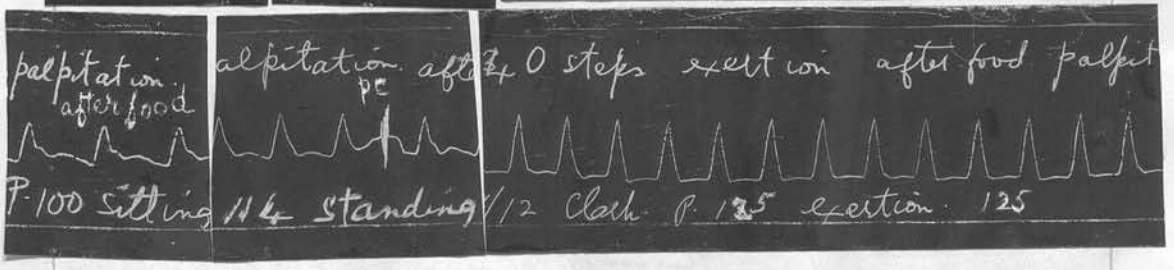


Fig 7. Male age 29.
(Systolic Press. before food 130 (Syst. Press after food 135
(Diastolic " " " 95 (Diast. " " " 90

In this case it will be noted that there is a great fall of pressure on exertion, the artery being apparently very empty during diastole. The pressure on standing after food also notably falls. The condition most resembles that induced by the inhalation of Nitrite of Amyl and that does not suggest the expediency of indulging in exercise. The diastolic collapse is due to dilatation of the arterioles, and this collapsing pulse and other such occurring during the processes of digestion, differs from the collapsing pulse of Aortic Incompetence in that the collapse takes its origin

from the peripheral and not from the Central end.
Compare with fig 68. in Byrom Bramwell's "Students' Guide to the Examination of the Pulse".

8

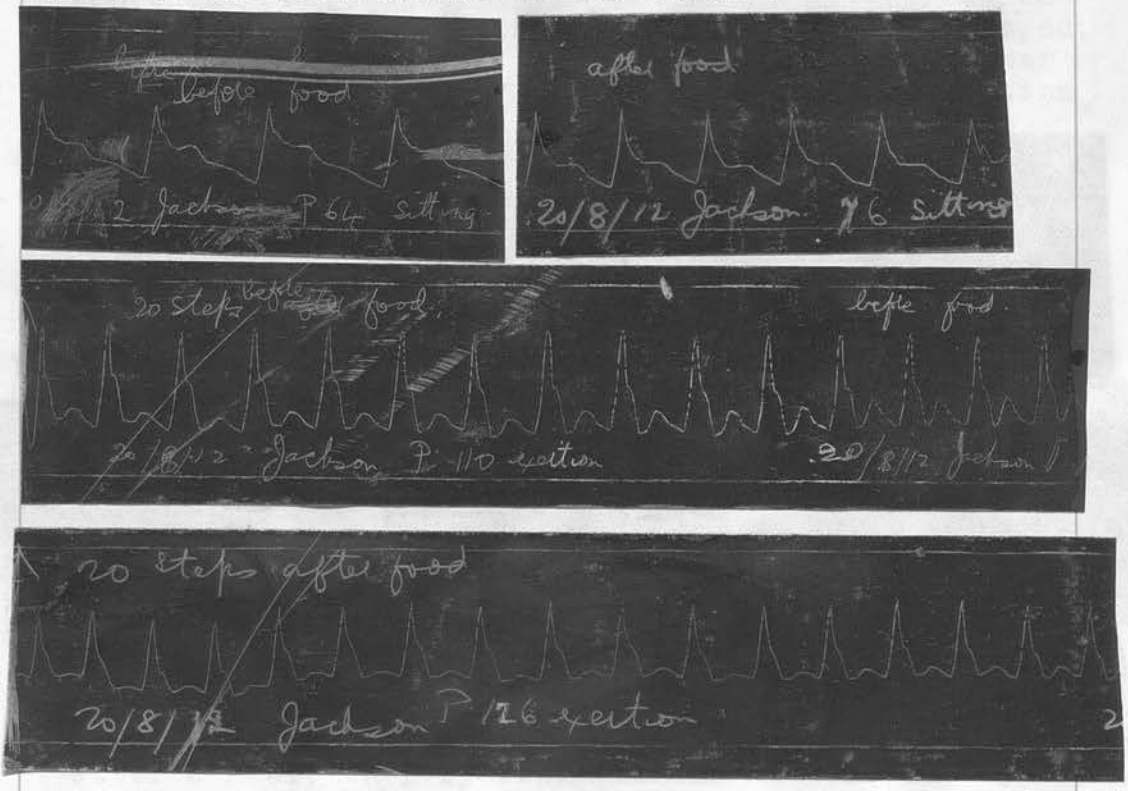


Fig 8. Male age 17. The pulse after food, sitting, is more sudden than that before, and on exertion the artery is apparently less full during diastole.
(Syst. Press. before food 130 (Syst. Press after food 140
(Diast. " " " 65 (Diast. " " " 70

9.

before food. after food.

Fig 9. In this case it will be noted that the Pulse tracing after food is more sudden and less sustained, especially on standing. On exertion, after food, the systolic portion and tidal wave are better developed, but the tension during diastole is apparently lower and the irregularity of the trace due to respiration, greater.

10

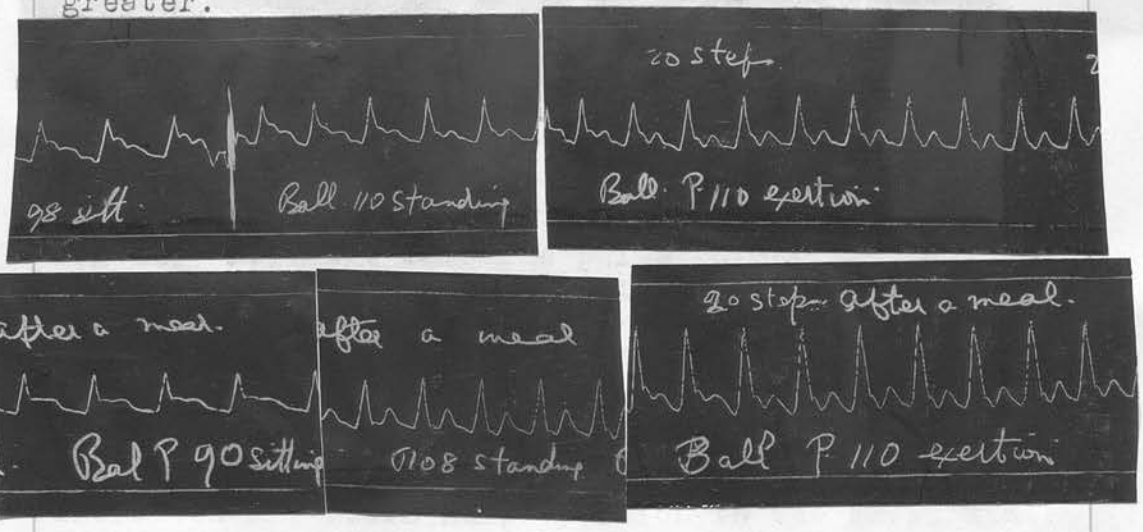


Fig 10. Male age 17. The systole after a meal in the pulse (sitting) is more sudden. On exertion after a meal, in proportion to the size of the systole, the diastolic portion of the tracing is less pronounced, But at that age exertion after meals is not so unpleasant as at a later age.

11

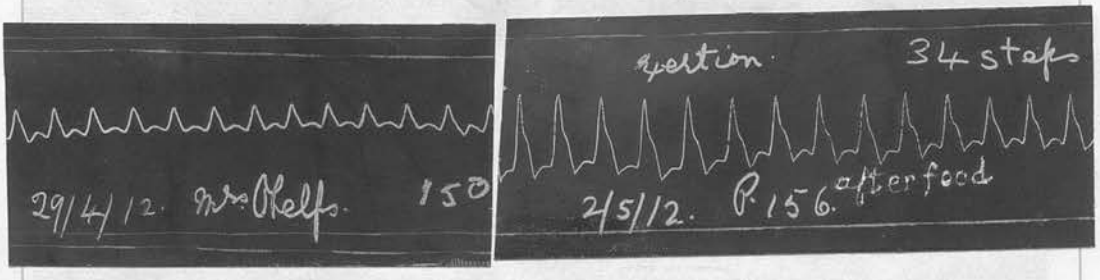


Fig 11. Female age 28. She suffers from palpitation after meals. The volume of the pulse was much larger after food, On exertion before food the pulse is fully dicrotous, while after meals it is hyperdicrotous, and is also greatly affected by Respiration. McKenzie (12) thinks that the main difference between a dicrotous and a hyperdicrotous pulse is a difference in the rate, but I think that the hyperdicrotous pulse indicates greater suddenness and a reduction in tension. The pulse tracings in this case resemble some shown by Mahomed, (13) that taken after meals resembling an untreated Mitral case and that before, the case after treatment. He describes them thus "The pulse (before the administration of digitalis) is rapid; splashy and dicrotic; the systolic collapse in the tracing is sudden and the diastolic expansion large".

12

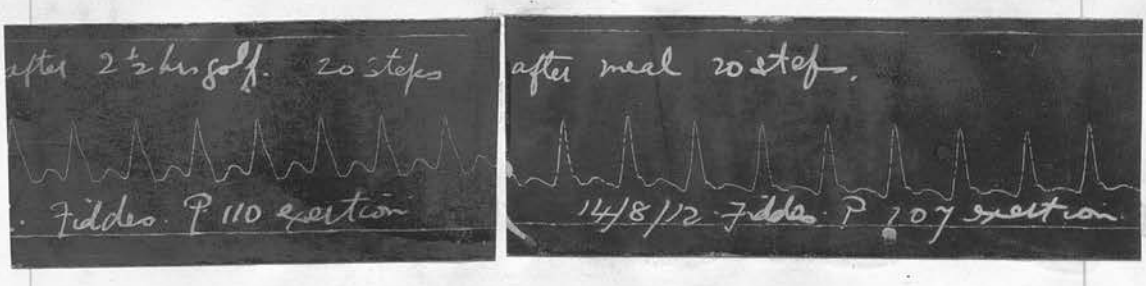


Fig 12. Male age 30. The pulse before food will be seen to be somewhat hyperdicrotous. It is not however so sudden as that taken after the meal, and there is evidence of a predicrotic wave higher up the tracing, while after food this falls to a low level in the tracing. The tracing after food resembles a tracing of Aortic Incompetence shown by Mahomed (13) and described thus:- "the percussion wave is greatly increased and bears no proportion to the small tidal wave: the dicrotic wave is very slight".

13

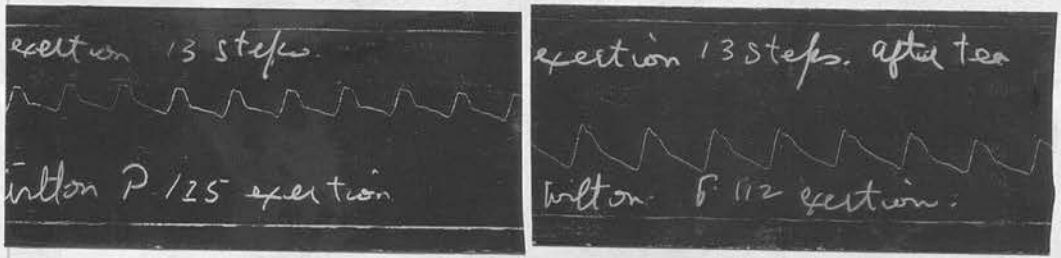
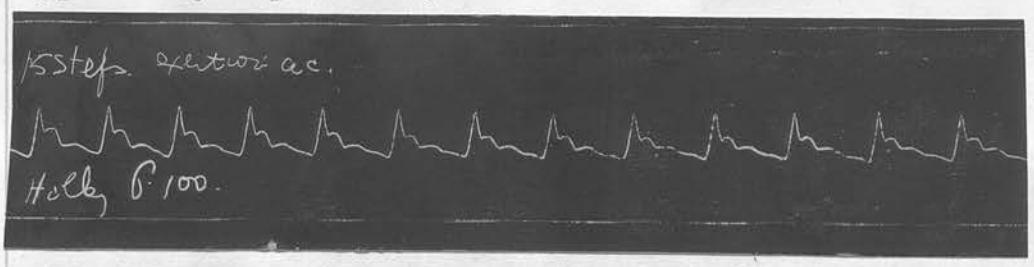


Fig 13. Female age 27. In this case the tension is apparently improved by the meal.



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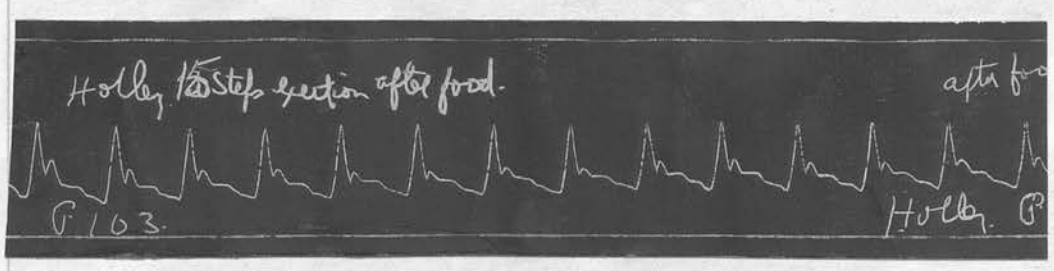


Fig 14. Male age 36.

Before Food.

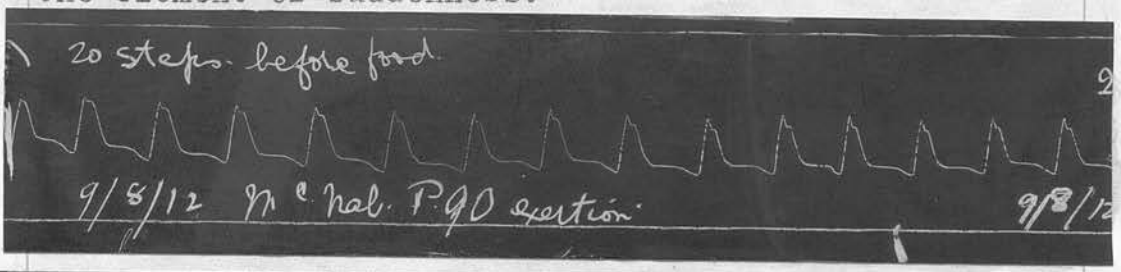
(P. Sitt. 76	(P. Stand. 77
(Syst. Press. 145	(Syst. Press. 145
(Diast. " 100	(Diast. " 95

After Food.

(P. Sitting 74	(P. Stand. 77
(Syst. Press. 155	(Syst. Press. 145
(Diast. " 100	(Diast. " 95

On exertion after meals there is a tendency to absorption of the Predicrotic wave and the tracing resembles one described by Mahomed (13) presenting "a large full pulse with a well marked percussion wave, indicating an excited action of the Heart". It certainly shows the element of suddenness.

15



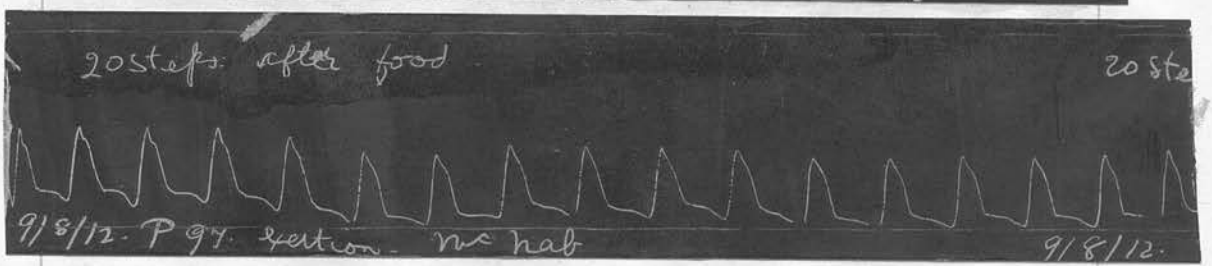
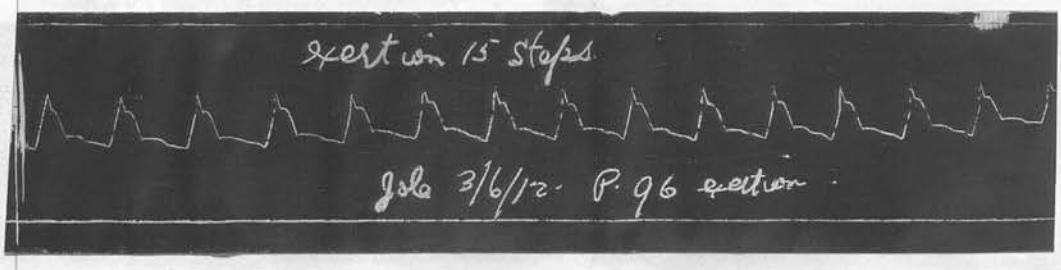


Fig 15. Female age 58. On exertion there is a greater tendency to flattening of the diastolic period and to respiratory irregularity.

16.



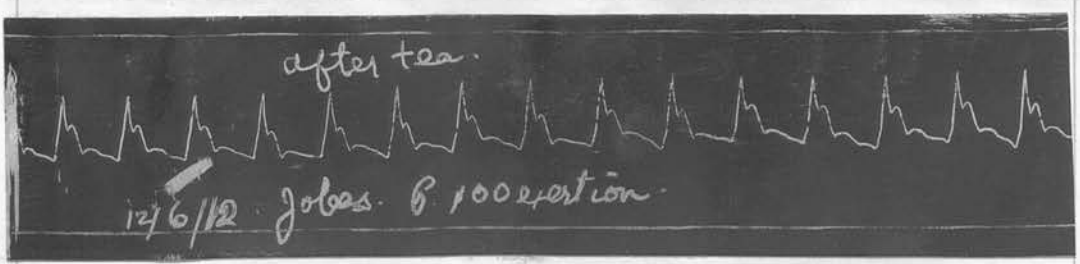
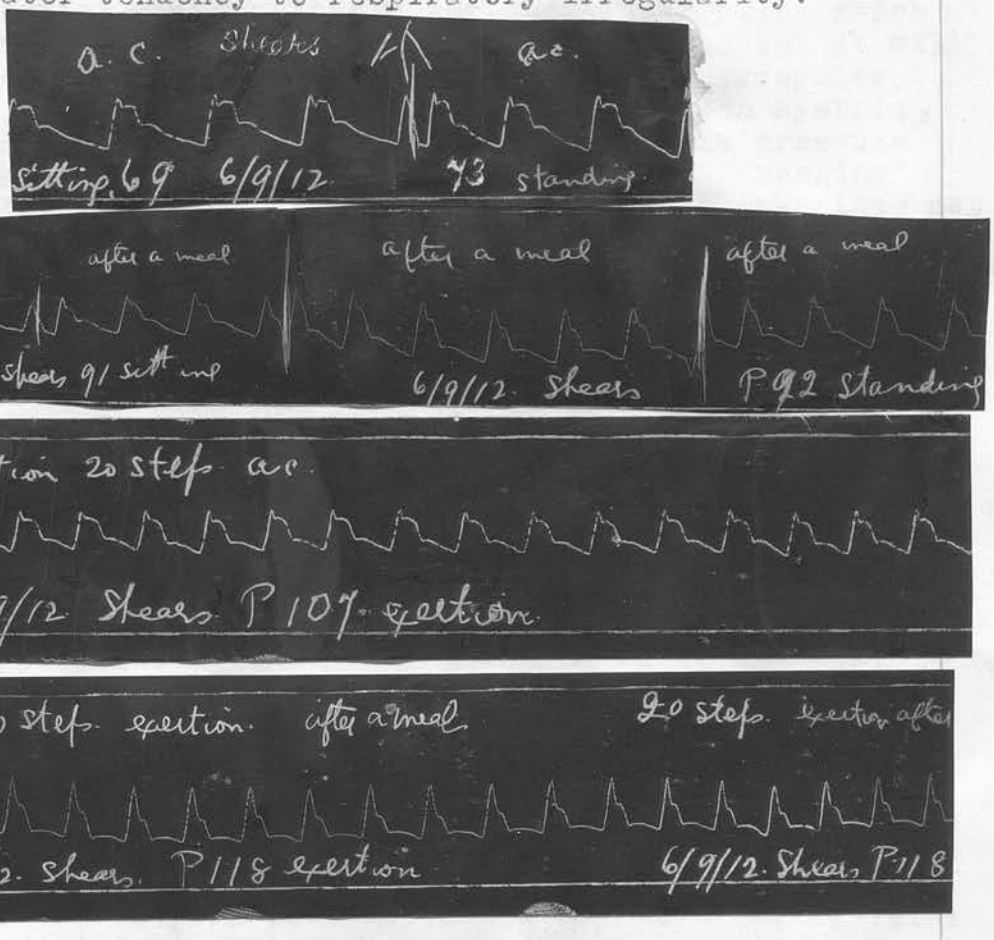
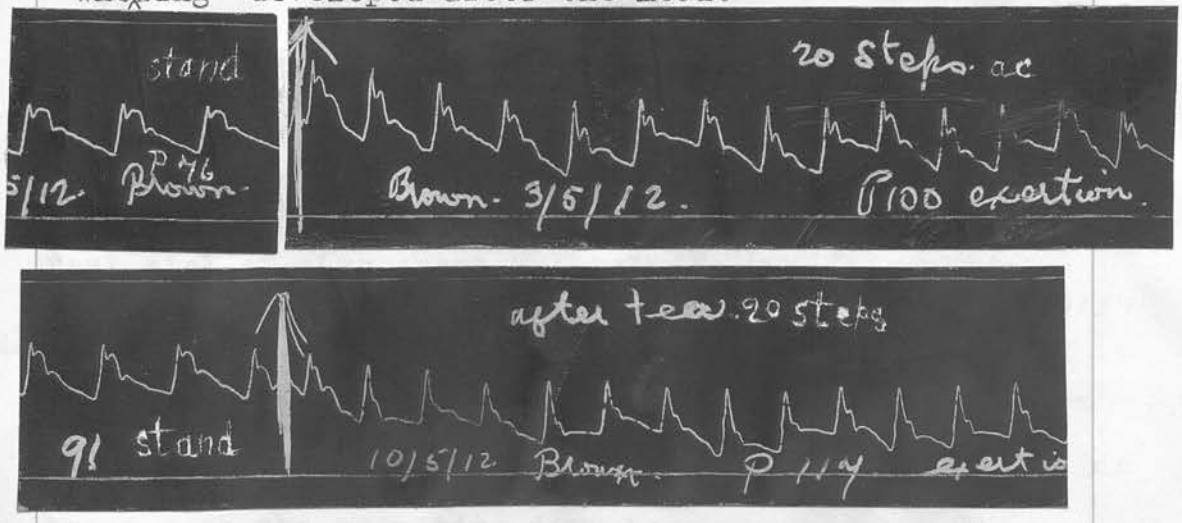


Fig 16. Male age 89. The pulse after food is more sudden; the diastolic portion is flatter, and there is a greater tendency to respiratory irregularity.



17.

Fig 17. Female, age 66. She suffers from Bronchitis It will be noticed that on standing after a meal, there is a greater tendency to a fall of pressure than before, though the postural difference in rate is less. On exertion there is a distinct fall of pressure and marked flattening of the pulse tracing during diastole. The rate is also faster, and the systole more sudden and less sustained. In this case "whezing" developed after the meal.



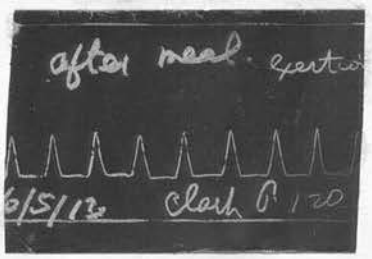
18

Fig 18. Female, age 69. She suffers from Bronchitis and has a high tension pulse (systolic Pressure 180). On exertion she develops a very irregular pulse which is described under the section on Exertion, but it will be seen that after food the pulse is more irregular, has a less sustained pressure, a more sudden systole, and a greater tendency to flattening of the pressure during diastole. She also suffered from "wheezing" and dyspnoea after meals. Bramwell (10) thinks this may sometimes be due to reflex Vagus action, but in the last two cases there were signs that the circulation was not so well maintained after meals and possibly the "suction action" of the Left Ventricle was not so efficient.

The effects induced in the pulse by various agents are more easily demonstrated in the mobile pulse of the young, but in the last few cases it will be seen that it is possible to trace the effects even in the aged with a more stable circulation and higher tension.

That meals induce some change I think few will deny, but those who have investigated these changes by means of blood pressure observation have obtained varying results. I don't think that the actual blood pressure changes are so important as the more subtle changes unrevealed by the Sphygmometer, and it is through an attempt to get nearer to these changes that the experiments detailed above were conducted. The method is perhaps crude, and I may have been partial in my decisions, but I certainly think that in my observations the bias was towards the position I have taken up, and this makes me conclude that meals and digestion induce a pulse which, as compared with the ordinary pulse, is of a collapsing, badly sustained, and dicrotous nature.

19



Many neurotic people with unstable circulations feel sick if they exert themselves after a meal and in some cases diarrhoea is induced. This may possibly have some connection with Lienteric diarrhoea; but a peripheral circulation so badly maintained as that shown in fig 19 probably indicates great congestion of the circulation in the Splanchnic and Portal areas due to temporary inadequacy of the general circulation. This congestion may lead to exudation of fluid into the Intestinal tract with the resulting diarrhoea. This may be

hypothetical, but it may sometimes happen.

CONCLUSIONS.

1. That meals tend to induce a splashing pulse, which shows a tendency to a fall of pulse tension on standing and on exertion.

2. That the important point is not the change of blood pressure, but the maintenance of the "Balance of the Circulation".

3. That in neurotic cases with palpitation, the circulation may be very badly sustained, causing the patient to suffer from breathlessness on exertion.

4. That rest after meals is physiological.

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2. Janeway. (The Clinical Study of Blood Pressure).
3. Goldwater (Medical News 1903. Vol. LXXXII).
4. Broadbent (The Pulse).
5. Oliver (Blood and Blood Pressure 1901).
6. Oliver (Studies in Blood Pressure 1908).
7. Hirschfelder. (Diseases of the Heart)
8. Erlanger & Hooker (quoted by Hirschfelder).
9. Gibson (Brit. Med. Jour. Oct. 1906).
10. Bramwell (Diseases of the Heart).
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13. Mahomed (Medical Times and Gazette 1872).

IV

The Effect of alcohol on the circulation.

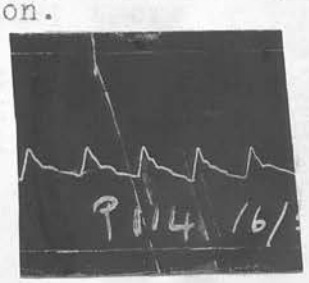
IV. THE EFFECT OF ALCOHOL ON THE CIRCULATION.

Of the effect of Alcohol on the Circulation it may truly be said that the main symptoms are subjective, but objective observations may reveal a few facts. The effects noted by different observers must of necessity vary according to the dose or overdose taken and to the Physiological or Pathological state attained by the devotee. Many of the conclusions come to have been based on Laboratory experiment.

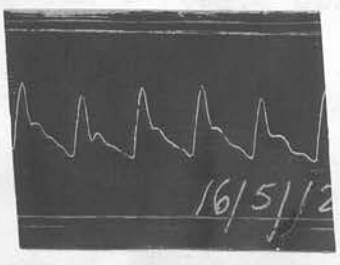
Here follow some expert opinions on the subject. Cushny (1) says that "when a large dose of Alcohol is given, it causes a fall of arterial pressure by weakening of the Vasoconstrictor centre and the Heart." Edgecombe (2) and Gibson (3) credit it with causing a fall of pressure while Broadbent's (4) view is, that "Alcohol increases the pulse rate and dilates the peripheral vessels". Hale White (5) maintains that "in over-indulgence in Alcohol the patient has a rapid and weak pulse and the rate is greatly increased by exertion, which in health would hardly affect it, Slight exertion makes the pulse weak and irregular". Hill (6) states that "Alcohol renders systolic output incomplete, increases the diastolic pressure and causes dilatation of the Heart. It lowers the arterial tension". Dixon (7) says that "Alcohol has little effect on the rate of the Heart in moderate doses; it dilates the superficial vessels and constricts internal vessels. In moderate doses it increases the activity and output of the Heart and in failure of the Circulation it raises blood pressure due to stimulation of the Heart. In normal men the systolic pressure may rise a little or remain unchanged, the diastolic tends to diminish".

The general trend of opinion suggests a lowering of blood pressure following the ingestion of Alcohol, and my observations also point in that direction. Besides lowering blood pressure however, Alcohol distinctly stimulates the Heart and this adds to the difficulty of experimental work on the subject. In many cases Alcohol increases the pulse rate, but in general I agree with Dixon that it has little effect in this direction, and in many of my cases a fall of pulse rate occurred. Alcohol dilates the peripheral arterioles and the result is a full and throbbing pulse. Fig 1. shows the effects of Alcohol, where 1a. shows the pulse tracing before and 1b. after the administration.

1.a.



1 b



The series of tracings next shown were taken from persons who had taken a physiological quantity of beer from ½-1 pint, and that they demonstrate so few changes is due to the fact that besides lowering the blood pressure Alcohol stimulates the Heart. A lowering of the blood pressure was the usual finding. One would fancy that in this country the effects of excessive dosage, could readily be studied; but opportunities did not present; and the effect of a pint of beer, on men who had never been known to succumb to its influence, must have been negligible.

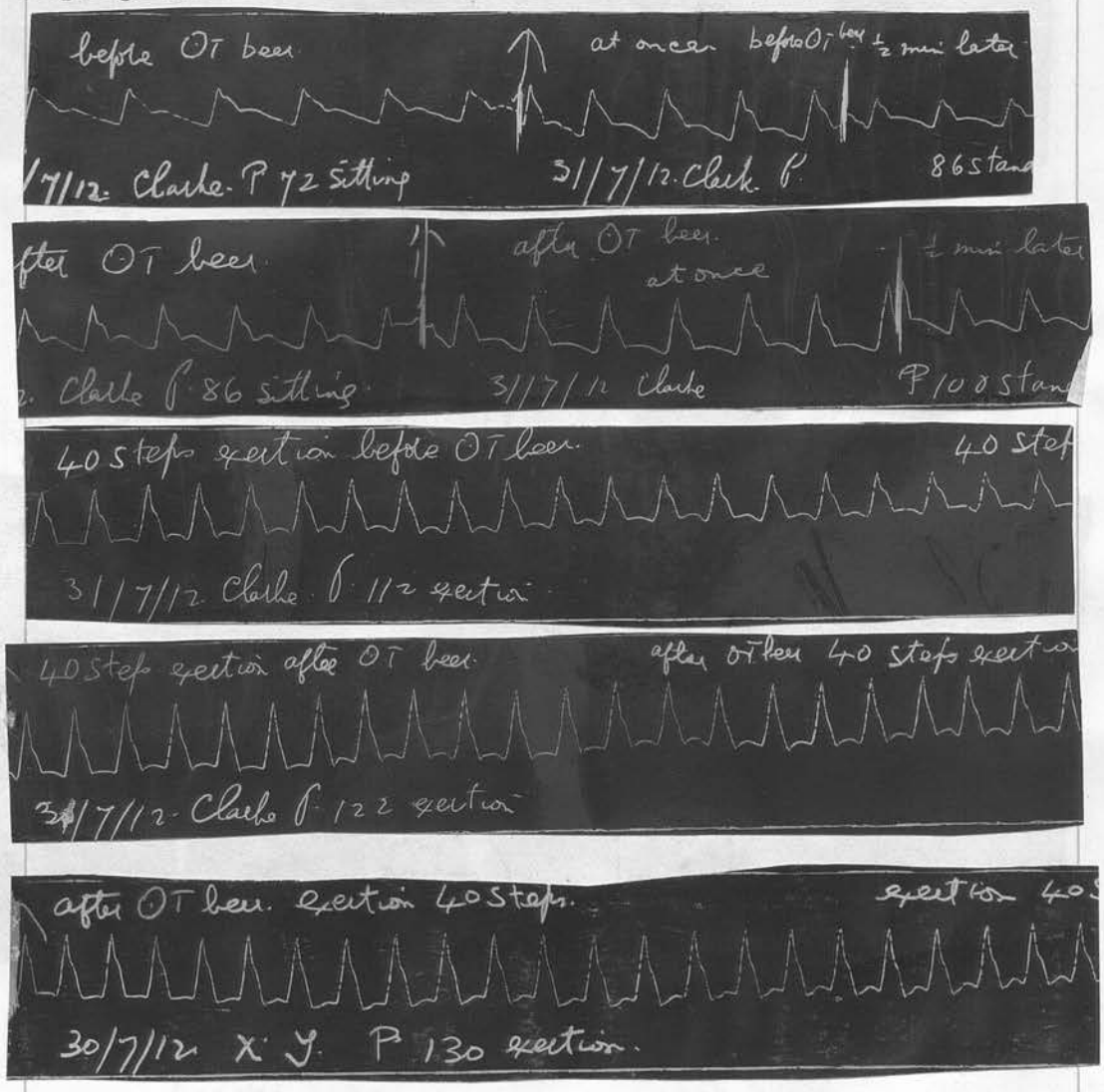


Fig 2. Male age 29.
(Syst. press. before beer 140 (Syst. press after beer 125
(Diast. " " " 100 (Diast. " " " 100.
Beer (1 pint) makes the pulse more dicrotous and on standing after beer there is a more marked fall of pressure. On exertion, after beer it will be noted that there is a more sharp and sudden systolic contraction, more respiratory irregularity, and a greater tendency to flattening of the pulse during diastole, and to hyperdicrotism. In this case Alcohol markedly increased the rate.

3.

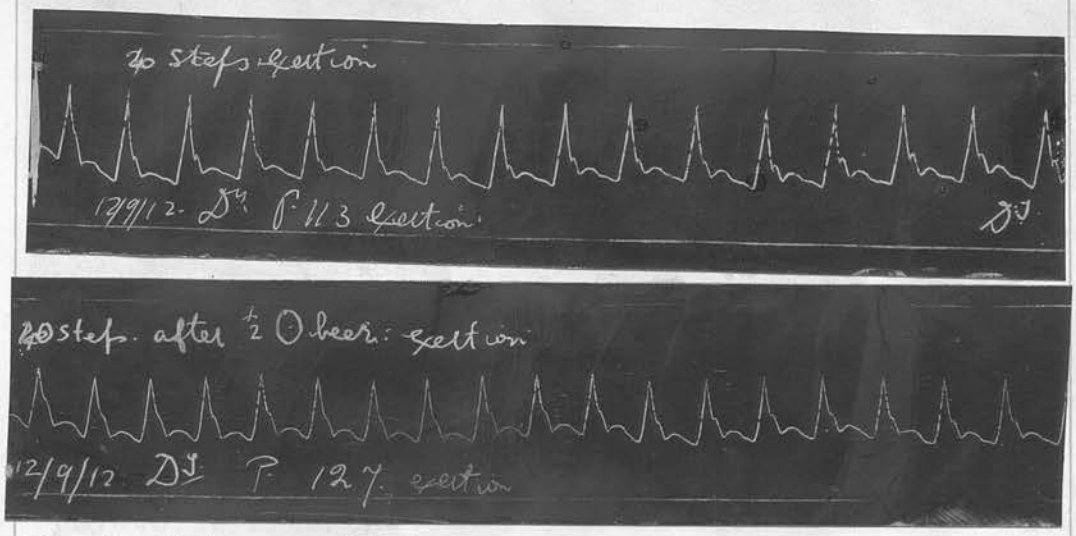


Fig 3. Male age 47.

Before Beer.	After Beer.
(P. sitting 75	(P. sitting 80
(P. standing 80	(P. standing 84.

Only ½ pint of beer was taken. It had not much effect, but the systole is probably more sudden and the respiratory irregularity is somewhat greater. The rate is increased.

4

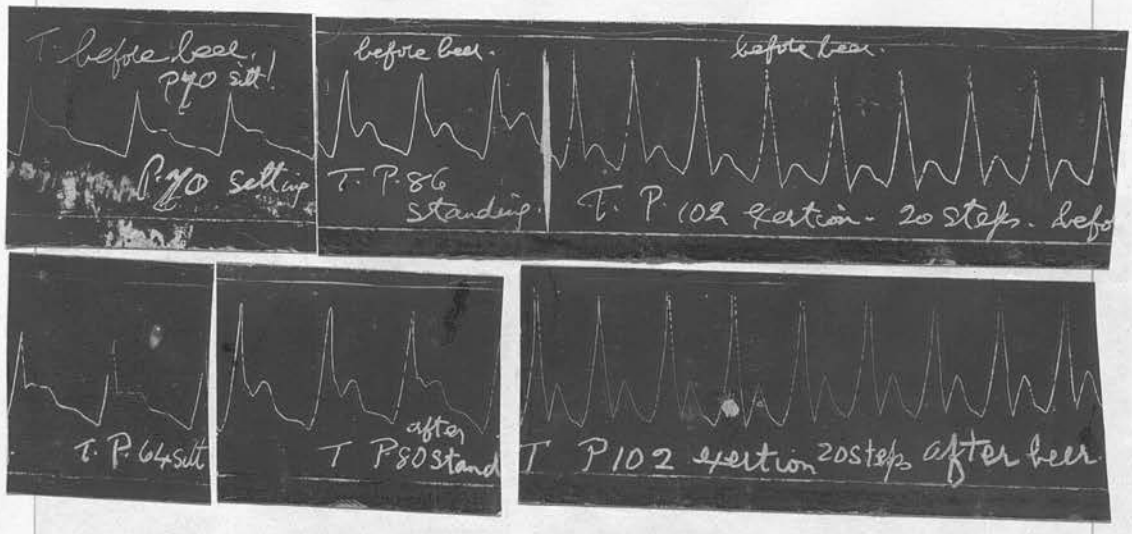
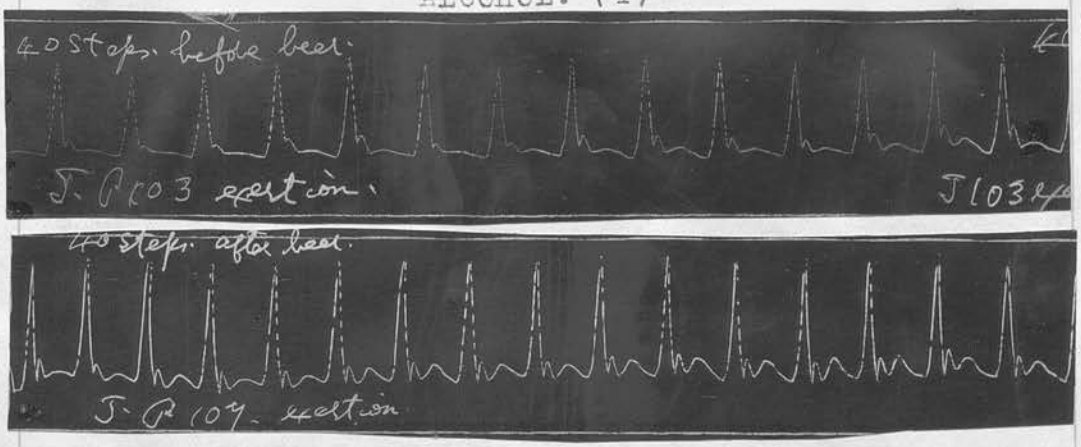


Fig 4. Male age 29.

Before Beer.	After Beer.
(P. sitting 70.	(P. sitting 64.
(Systolic Press. 150.	(Systol. Press. 135.
(Diastolic Press. 70	(Diastol. " 80.

After beer the Auscultatory Throbbing (in the Sphygmometer examination) was less pronounced. On exertion (after beer) the systolic contraction is quicker and the diastolic elevation is sharper and recedes more quickly - a collapsing pulse. In his case Alcohol (1 pint of beer) reduced the Blood pressure and pulse rate.

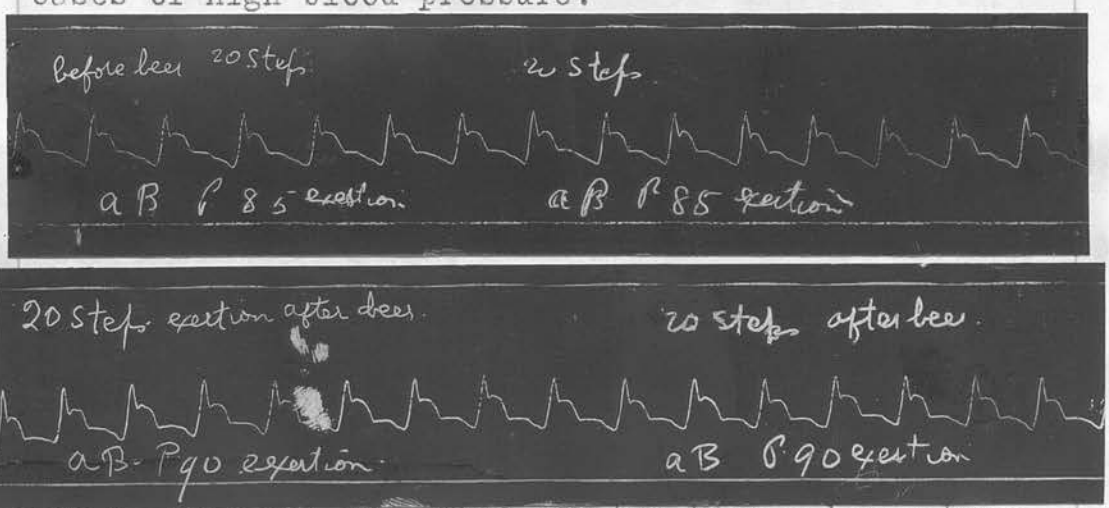


5

Fig 5. Male age 18.
(Before beer P. sitting 61. (After beer P. sitting 63
(Systolic Pressure 140 (Systolic Pressure 130

The auscultatory Throbbing (with Sphygmometer) was weaker after beer. In this case, after ($\frac{1}{2}$ pint of beer) it will be seen that exertion induces a very quick systolic contraction, the pulse after systole apparently collapsing to as low a point or lower than at the end of diastole. The element of suddenness is well marked, and the pulse undoubtedly undergoes more variations during its course than before.

The next few cases were taken from hardened consumers, and little effect is shown, but they all undoubtedly show a tendency to the developement of a dicrotic pulse and that in itself means something in cases of high blood pressure.



6

Fig 6. Male age 47. This man has been a heavy beer drinker all his life. Before coming up he had taken 2 pints of beer and he took 2 extra pints without showing any appreciable effect. The tracings taken differ very slightly from those taken when in a more sober state next day. After beer there is a slight tendency to dicrotism in the ordinary pulse and on exertion there is a tendency to a more sudden fall towards the end of diastole. This case rather shows the effect beer does not have.

7

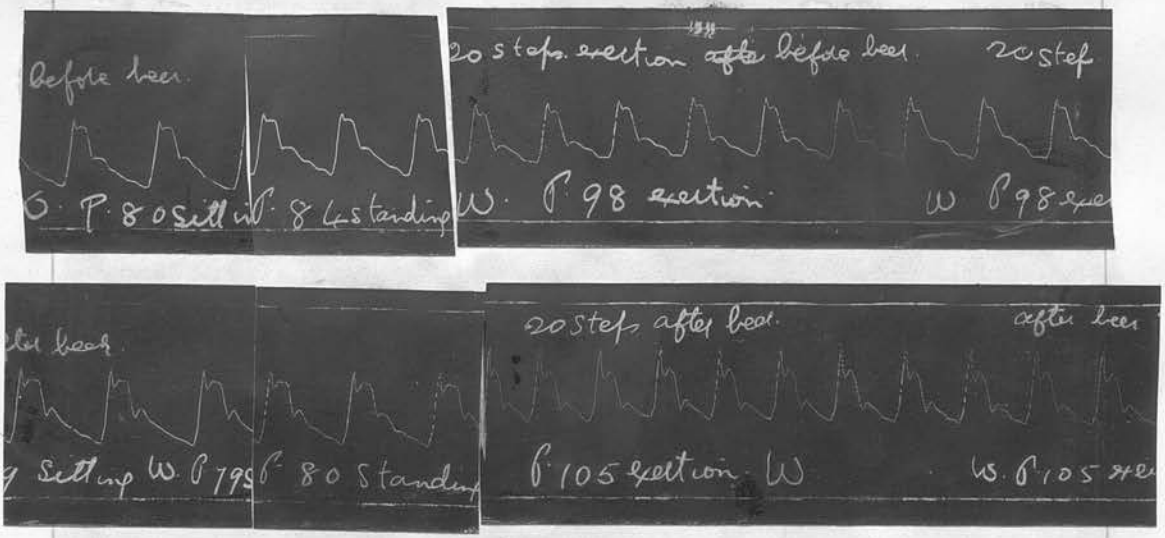


Fig 7. Male age 72. One pint of beer was taken. In this case it will be noted that after beer the pulse has a distinct tendency to become dicrotous in the ordinary state and after exertion. However many writers, such as Roy & Adami (8) Sansom (9) Galabin (10) Ewart (11) Lewis (12) etc. may differ as to the causation and interpretation of dicrotism, they are generally agreed that the chief essential for its production is a quick and sudden contraction of the Heart. It will be found that most men experience a greater degree of breathlessness on exertion after beer than before, and this unsustained condition of the Circulation may explain that, for the change produced somewhat simulates the dicrotism and suddenness induced in the pulse by Fever.

8

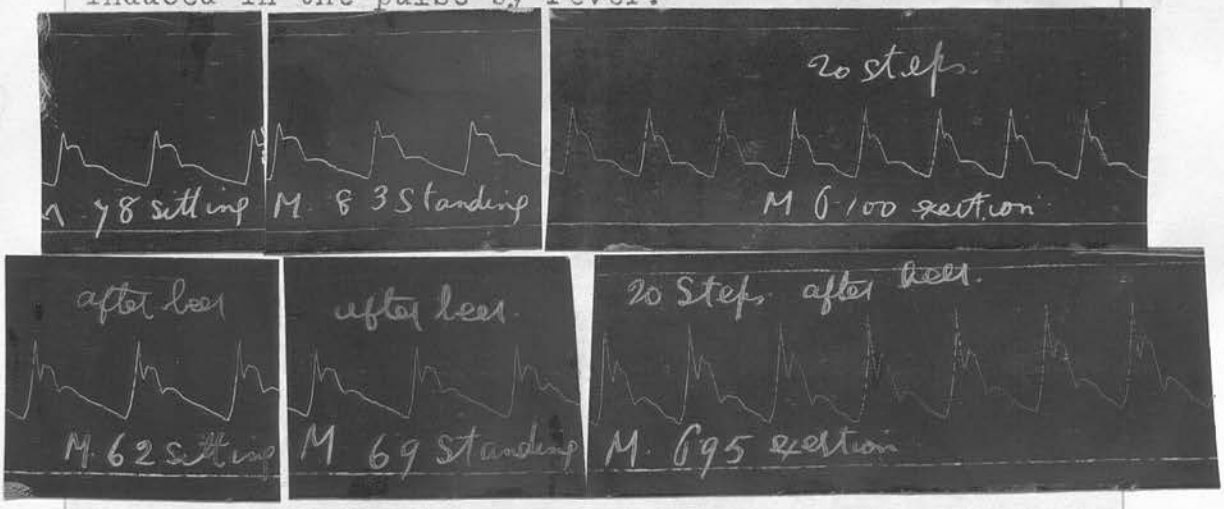


Fig 8. Male age 42; a maltster who is in the habit of taking 4 pints of beer a day. One pint has no great effect on him, but he finds the effects intensified if he smokes while taking his beer. There is a double aortic murmur and the apex is 5 inches from the middle line. He has served in the Army abroad.

(Before beer P. sitting	78	(After beer P. sitt.	62
(Systolic Pressure	140	(Syst. Pressure	130
(Diastolic "	70	(Diast. "	60.

The auscultatory throbbings (by Sphygmometer) are fainter after taking 1 pint of beer. The pulse in this case is not typical of aortic incompetence, but it was a jerky pulse which became more splashing after beer. It also becomes more dicrotous and this is best marked on exertion. The blood pressure and the pulse rate are both reduced. He is more breathless on exertion when he has had beer.

9

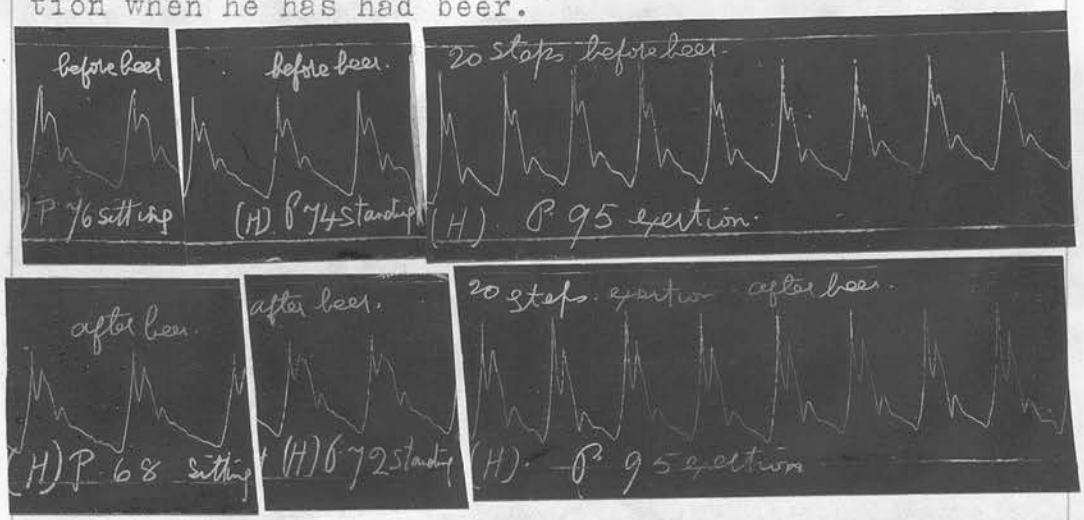


Fig 9. Male age 75.

(Before beer P. sitting	76.	(After beer P. sitting	68.
(Systolic Pressure	190.	(Systolic Pressure	175.
(Diastolic "	105.	(Diastolic "	100.

In this case the pulse becomes more full and dicrotous after beer (1 pint) and this is more marked on exertion, where the suddenness is much greater. The pulse pressure and pulse rate are both markedly reduced.

10

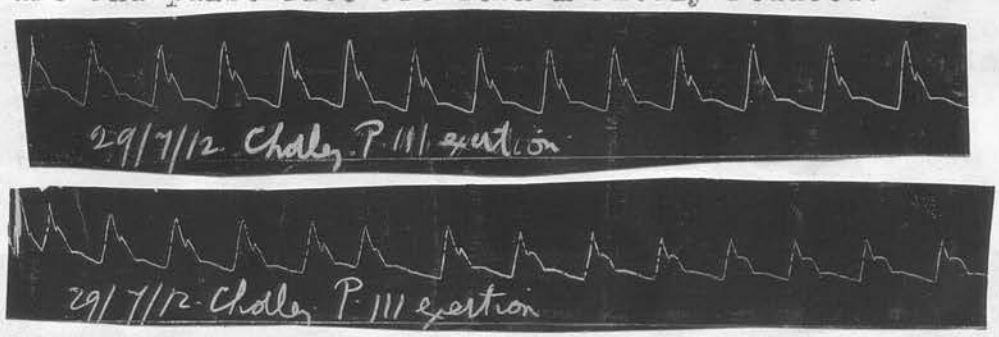


Fig 10. Male age 69. Exertion after beer has had little effect on his pulse but he merely had one half pint. There is one premature systole after beer at the 6th. pulsation but this might have been accidental.

11

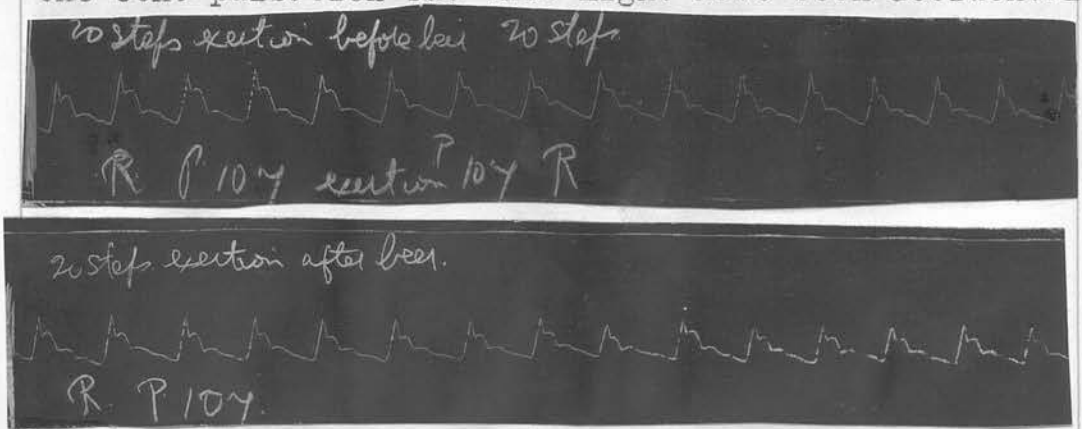
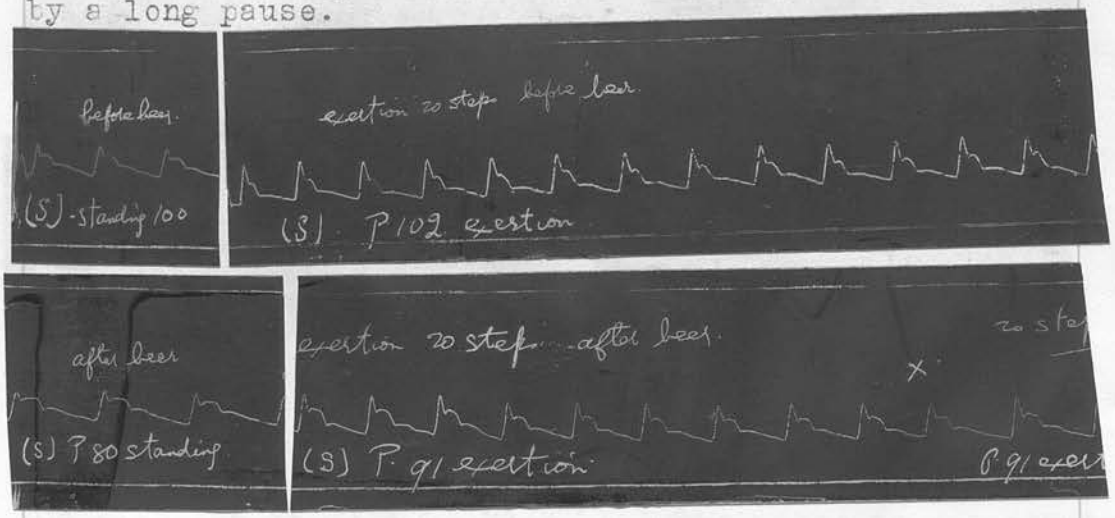


Fig 11. Male age 70. He had one pint of beer.

(Before beer P. sitting 75 (After beer P. sitt. 70
(Syst. Press. 170. (Syst. Press. 185

The blood pressure seemed to be raised in this case. There is little change on exertion but the 9th. beat after beer is a premature contraction and is followed by a long pause.

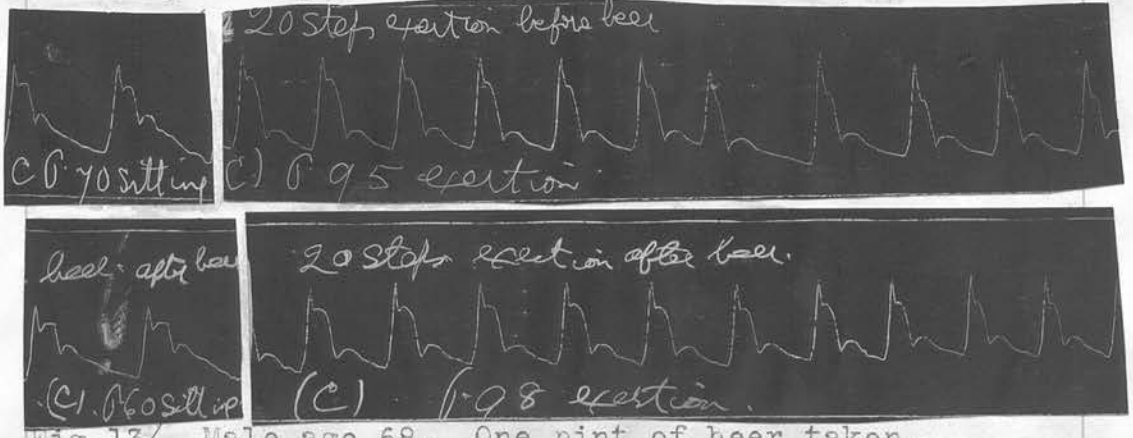


12

Fig 12. Male age 78. One pint of beer was taken.

(Before beer P. sitting 84 (After Beer P. sitt. 76
(Systolic Pressure 145. (Syst. Pressure 145
(Diastolic " 110 (Diast. " 100.

It will be seen that the pulse is more full and slower after beer and this also applies to the pulse during exertion though there is really very little change. The 10th. beat on exertion after beer, seems to be of the nature of a premature beat. In the last three cases, whether accidental or not, there has been the tendency to a premature beat on exertion after beer.



13.

Fig 13. Male age 68. One pint of beer taken.

(before beer P. sitting. 70 (After beer P. sitt. 60
(Syst. Press. 160 (Syst. Press. 130

In this case there is little change but Alcohol induces a more full and bounding beat. On exertion before beer the 7th. beat is premature but after beer there is also some slight irregularity about the size of the 8th. beat. The pulse is slower after beer.

14

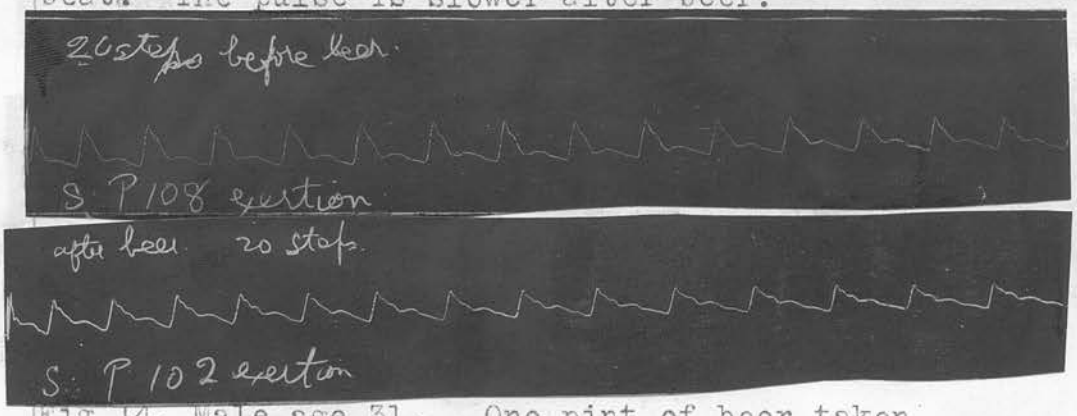


Fig 14. Male age 31. One pint of beer taken.

(Before beer.	P. sitting.	79.	(After beer.	P. sitt.	75.
("	" Syst. Press.	130.	("	" Syst. Press.	125.
("	" Diast. "	95.	("	" Diast. "	110.

On exertion it will be seen that the pulse is relatively more full during diastole after beer. In his case the pulse pressure and pulse rate were reduced.

15.

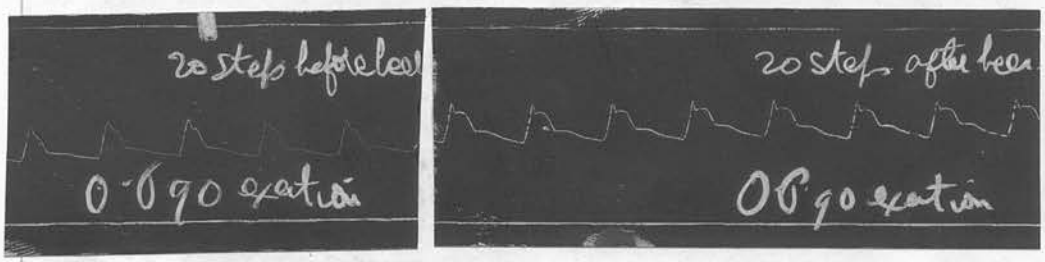
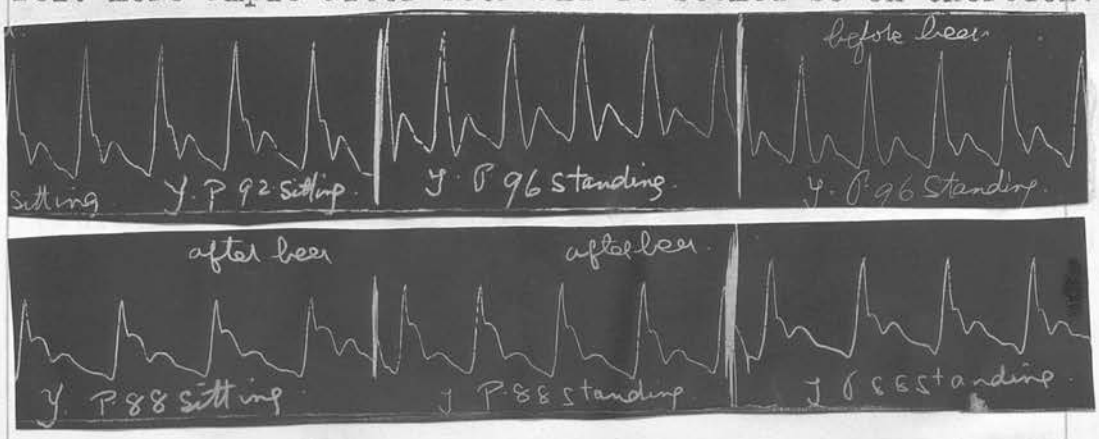


Fig 15. Male age 71. One pint of beer taken.

(Before Beer.	P. sitt.	74	(After Beer	P. sitt.	74
("	" Syst. Press.	155	("	" Syst. Press.	140
("	" Dias. "	100	("	" Dias. "	95

In his case there was a reduction in Systolic blood pressure, but no reduction in pulse rate. The pulse felt more ample after beer and it seemed so on exertion.

16



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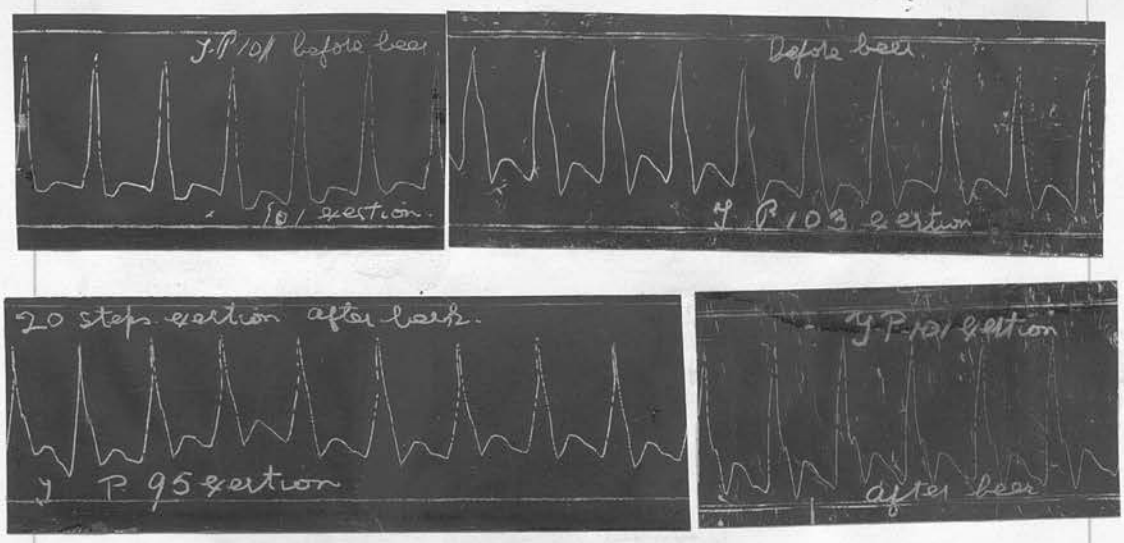

Fig 16. Male age 63. One pint of beer was given.

Before beer P. sitt. 92. After beer P. sitt. 88
(Syst. Press. 150 (" " Syst. Press. 135
(Diast. " 90 (" " Diast. " 90

He suffers from occasional Bronchitis and on examination of the Heart I found that he had a Mitral systolic murmur. The apex was at the nipple line and he had oedema of the ankles and congested veins along the Costal Margins. In his case the beer seems to have stimulated the Circulation and produced a better systole on standing up the pulse tension does not fall as it did before beer. On exertion also, the tension has improved and there is less tendency to hyperdicrotism and to flattening of the diastolic period.

17.

Fig 17. Male age 30. One pint of beer taken.

(Before beer. P. sitt. 92. (After beer. P.sitt. 84
(" " Syst. Press. 130. (" " Syst.Press. 120
(Di " " Diast. " 90. (" " Diast. " 80

In this case it has very little action, but he was

accustomed to the effects of beer.

In another case:-

(Before beer.P. sitt. 89	(After beer.P. sitt. 80
(" " Syst.Press.170	(" " Syst. Press.155
(" " Diast. " 120	(" " Diast. " 110

It will be seen that in a great number of the cases there is the combination of a reduction in systolic blood pressure and in pulse rate after taking Beer. In some cases little change is noted in the pulse but so many of the men available were men who were in the habit of consuming considerable quantities of beer.

18

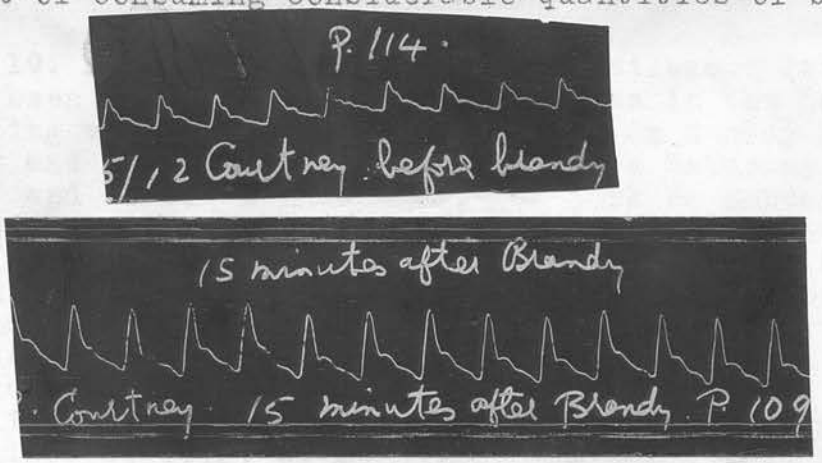

Fig. 18. The above tracings were taken from a male patient aged 78 who was dying, two days after the crisis, from Pneumonia. The pulse was very small when the first tracing was taken, and a quarter of an hour after administering a tablespoonful of Brandy in warm water, the second tracing was taken. The pulse has increased in volume and the pulsations vary in strength and resemble somewhat 'Pulsus Alternans', saving that the irregularity is more irregular and often occurs at every third beat, or two small beats occur together. The irregularities are probably caused by Respiration, and they resemble the irregularities somtimes found after exertion. It may be possible that there were irregularities in the pulse before Brandy was given, but theyshow up better in the larger pulsations after the administration. It may be possible however that Alcohol and other stimulants induce a certain measure of irregularity in stimulating a failing Heart. This question is also asked in connection with the next case.

19 (a)

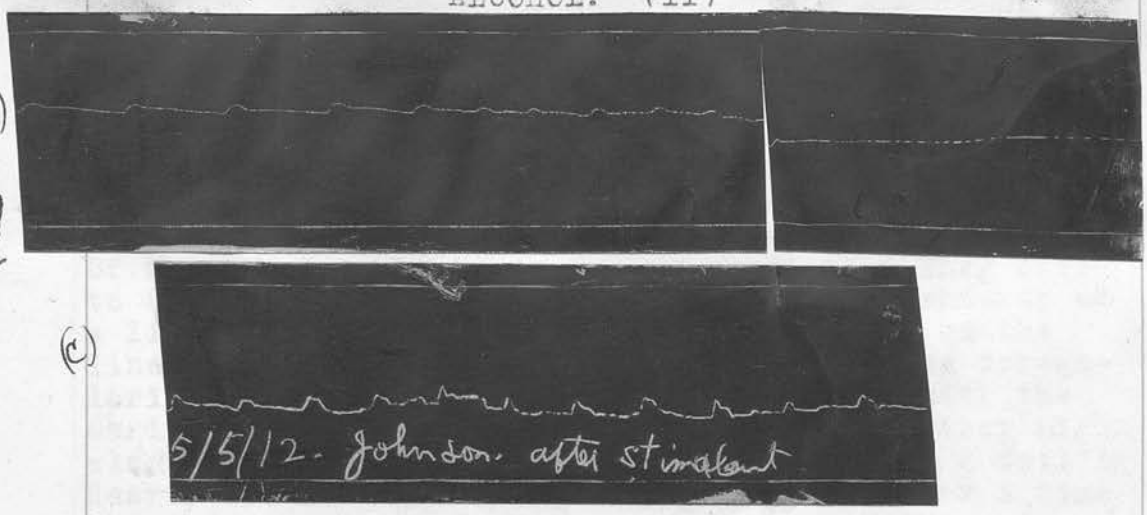

Fig 19. Male age 47. Acute Heart Failure. Patient had been a very heavy drinker and was in the habit of getting very drunk every week end. On Sunday he was sick and miserable as the result of a Saturday night's bout and he did not feel fit for work on Monday or Tuesday. On Wednesday I saw him, and he was then suffering from Gastritis, with coated tongue, but his condition was evidently improving. I prescribed some Bismuth Mixture for him, and by Thursday he felt much better, and was beginning to feel quite fit again by Friday. On Friday evening at 5. he complained of giddiness, of "everything going black" and he was inclined to faint on standing. He was forced to lie down on a couch, and I was sent for, but as I was out I did not see him till midnight. He was then restless, with flushed cheeks, respirations slow and sighing and pulse of 76. His temperature was not raised and he said he felt better, and would be all right by the morning. On feeling the pulse I found that it was small, soft, and evidently of very low pressure, and on auscultation of the Heart I heard a soft but distinct Mitral Systolic murmur, and very feeble Heart sounds. The apex was at the nipple line. From the softness of the pulse I suspected the onset of acute dilatation of the Heart, and so I returned and gave him a hypodermic injection of Strychnine and prescribed a mixture of Digitalis and Strophanthus. Next morning I found a still softer pulse, and the patient was bathed in a profuse sweat and suffered from mild rambling delirium. I took a Sphygmographic tracing of the pulse as shown (Fig. 19a). It resembles one shown by Sansom (9) to which he appends the following note:- "When the Left Ventricle is failing you get a long flat diastolic line with a systolic elevation at irregular intervals. The upstroke is short, sloping upwards and the first wave is sufficiently prolonged to form a flat plateau at the summit". On auscultation the soft Mitral Systolic murmur was heard, but only a faint 'tab' for the first sound, while the second sound could not be heard. I gave him a Hypodermic of Strychnine MV: of adrenalin MV and of Spiritus Aetheris MX. In a short time the pulse was more ample and

and apparently stronger, but it was irregular and in this fashion. Twenty to thirty full beats were followed by a period in which 20-30 exceedingly small beats occured, and these were again followed by the full beats. After 4 full beats, tracing B shows the inception of these smaller beats and towards the end of the tracing the beats are so small that they fail to affect the writing point. The tracing ends up as a line and the spaces seen between the dots on the line may represent abortive pulsations. The irregularities may have been due to interference with the Cardiac rhythm caused by the Adrenalin; but they might also represent the effects of a stimulant on a failing Heart, the Heart reacting to the stimulant for a time, and this over-stimulation resulting in an after depression. The possibility of the over-stimulation affecting the rhythm of the Heart was seen in connection with case (18). Tracing (c) was taken about an hour later and it will be seen that the pulse is of slightly better volume. The tracing however was difficult to obtain as there was a very marked Subsultus tendinum. The patient gradually failed and died at 5 that evening. This was, I consider, a case of Alcoholic Heart failure. Like many other Alcoholics this patient often experienced a "pain at the Heart" on the Saturday night and Sunday morning; but though this "pain at the Heart" is often treated lightly, or accepted as an indication of Gastritis, I consider that in many cases it indicates a certain amount of Cardiac dilatation; and as rubber loses its elasticity when too frequently and severely stretched, so repeated dilatation of the Heart will ultimately lead to a dilatation which is not recovered from.

This was a fairly sudden case of Heart failure but was gradual as compared with the next case.

Male, age 46. had for years been a great "soaker" and was in the habit of taking tremendous daily quantities of 'Dop' Brandy. He was not under Medical attention, but as I was attending another patient in the same house, he asked me to examine his Heart as he had a more or less uneasy feeling in the Heart region. He was a big powerful man, but had become bloated, flabby and fat; his cheeks were congested and there were congested venules round the Cardiac apex and the Costal Margins. The Heart extended to the nipple line, but apart from that there were no definite signs of Heart mischief, saving that the symptoms and the History pointed to the probable presence of fatty degeneration of the Heart. Three days later while walking across the room, he stuttered, struggled across towards the bed, and expired.

These last two cases, good examples of Alcoholic Heart failure, brought forcibly home to my mind the fact, that the uneasiness many men feel in the Cardiac area after a drinking bout, is due to a certain degree

of Cardiac dilatation.

When I was a student, a young man of about 35 in the country, used periodically to say to me "I must get you to examine my Heart; I think there's something wrong there," but it was noticeable that this suggestion of Cardiac uneasiness was generally made when he was recovering from the effects of a drinking bout. Graham Steell (13) has described Alcoholic Heart failure, but though this is a well recognised condition, it is not sufficiently and generally recognised.

CONCLUSIONS.

1. That Alcohol tends to reduce blood pressure.

2. That changes of a dicrotous nature are often produced in the pulse after the administration of Alcohol, causing breathlessness on exertion.

3. That over-doses of Alcohol produce temporary dilatation of the Heart, and that this ultimately leads to a dilatation which is not recovered from.

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13. Graham Steell (Med. Chron. Vol. XVIII).

V

The Effect of Excitement, Nitrite of Amyl, Warm Baths + Smoking on the Circulation.

V. THE EFFECTS OF EXCITEMENT: NITRITE OF AMYL: WARM BATHS AND SMOKING ON THE CIRCULATION.

1. EXCITEMENT.

Excitement seems to have the effect of forming a pulse wave which has a sharp and sudden systolic elevation; a very rapid fall, and a low diastolic expansion. McKenzie (1) describes the pulse in excitement as similar to that in fever and aortic Incompetence; and of palpitation he says "the pulse wave is sudden and of brief duration; the upstroke is high and the fall is great so that the arterial pressure at the bottom of the Aortic notch is nearly as low as at the end of the diastolic period". Galabin (2) says "A high sharp primary summit, followed by a sudden fall, may occur just as much in the pulse of simple excitement as in Aortic regurgitation. Sansom (3) holds that "in nervous palpitation we get an exaggerated upstroke, and the acute angle it makes with the downstroke shows that the contraction of the Ventricle is not sustained and that there is a very rapid diastolic expansion". Mahomed (4) shows a tracing indicating relaxation of the arteries and likens it to that found under nervous excitement. Broadbent (5) believes that in palpitation there is usually a sudden relaxation of the arteries; Bramwell (6) had the Sphygmograph on the wrist when the attack of nervous palpitation developed, and the most marked change in the tracing was a much larger systolic wave and a much lower diastolic expansion. The following tracings exhibit the effect of excitement on the pulse.

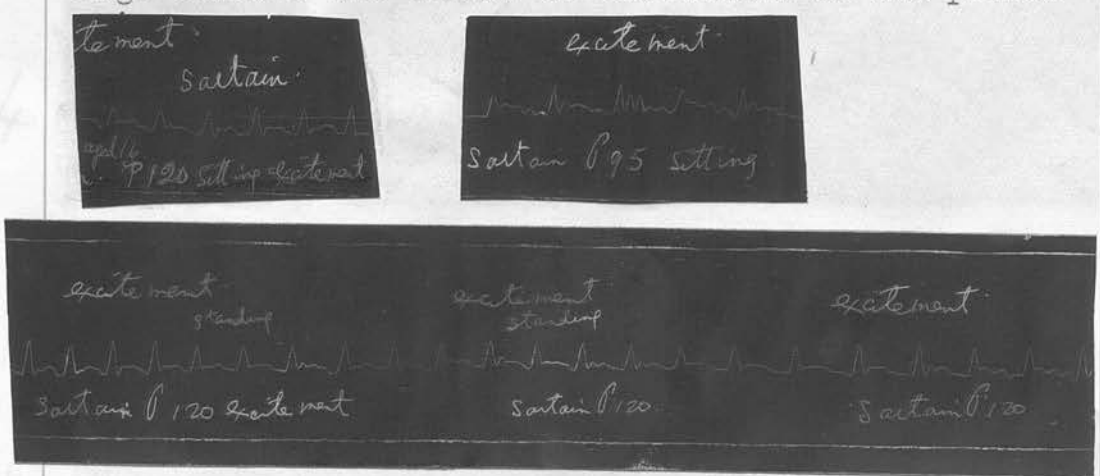

Fig 1. Female, age 16. Note the jerky, irregular and varying nature of the pulse wave; the sharp and sudden systole which often falls as low or lower at the end than at the beginning of the systole; and the irregular nature of the diastolic portion.

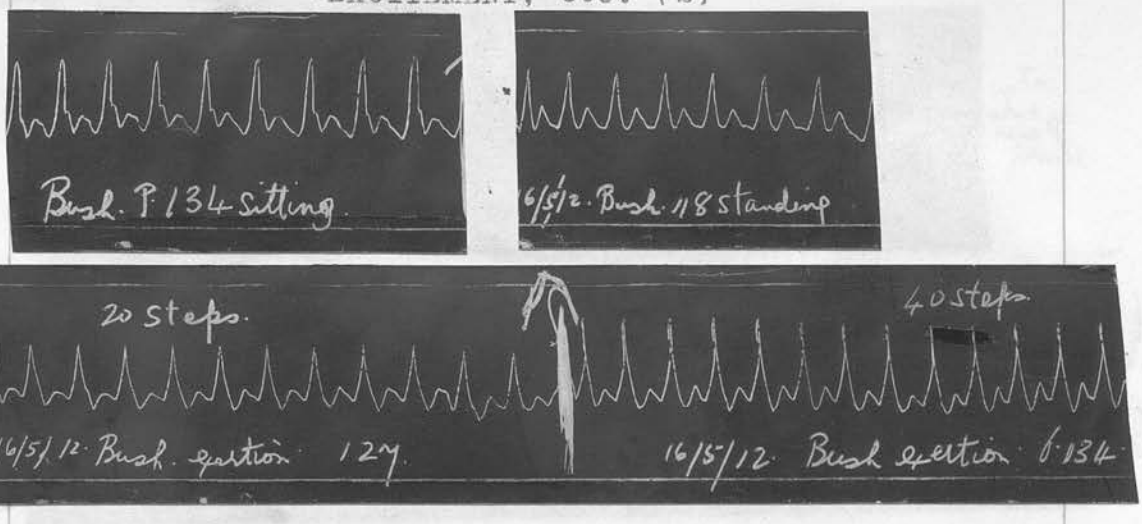

Fig 2. Male, age 18. He suffers from Epilepsy and got very excited while I took the tracing. The effect of exertion during excitement is shown and it will be seen that after 40 steps there is a greater variation in diastole. The systole is also much quicker.

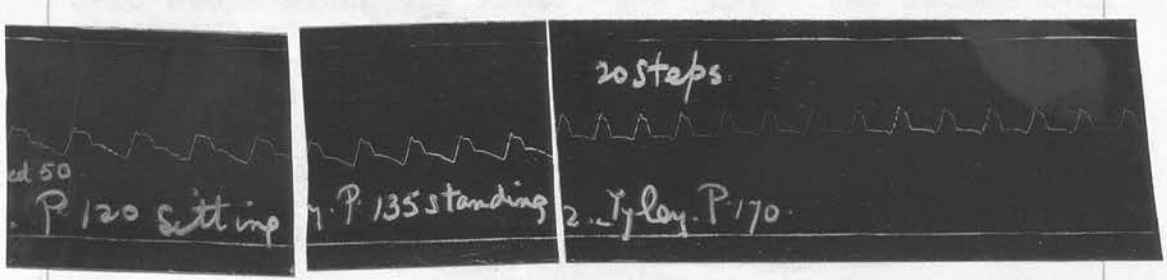

Fig 3. Female, age 50. She was very excited and this probably accounts for the low condition of pressure found during diastole. on exertion.

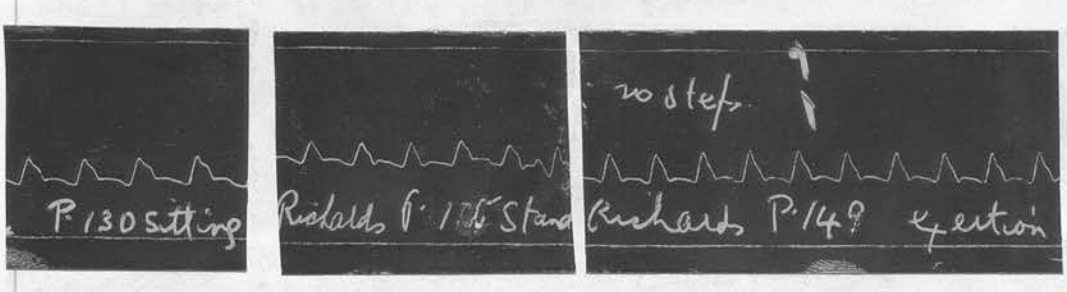

Fig 4. Female, age 44. Climacteric troubles. She was very excited and in her case it will be seen thatthe pulse tension falls very low on standing and on exertion.

5/

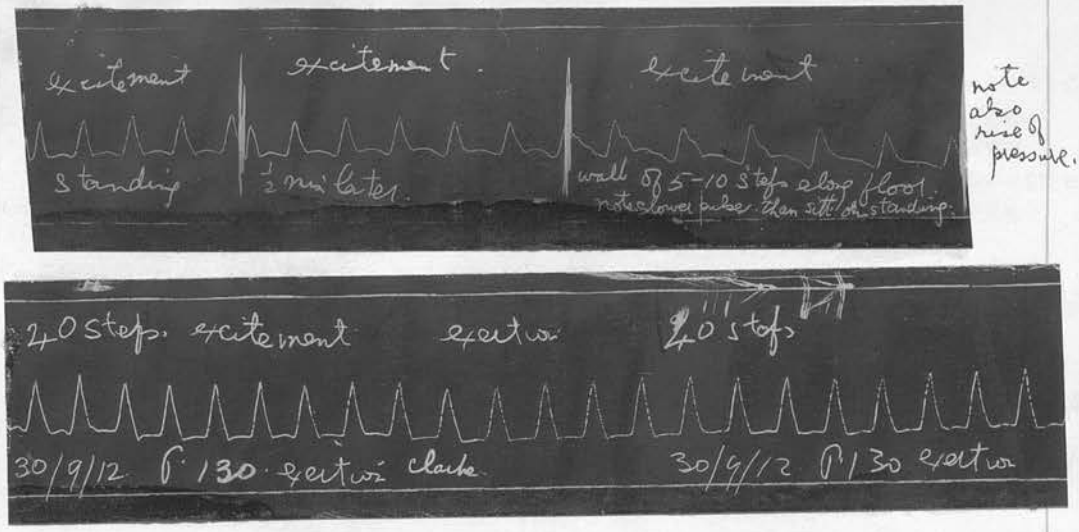

Fig 5. Male, age 30. Note the dicrotous pulse and the empty condition of the pulse during diastole, on standing and on exertion. It will be seen that on walking 5-10 steps along the floor, the pulsations become much stronger and the pulse much slower, confirming the opinion of some writers that a certain amount of exertion may reduce the pulse rate in excitement and nervous palpitation.

2. AMYL NITRITE.

The action of Amyl Nitrite on the Circulation has been thoroughly studied and the characteristic effects are well known and in connection with this subject I shall merely show the appended tracings.

6/

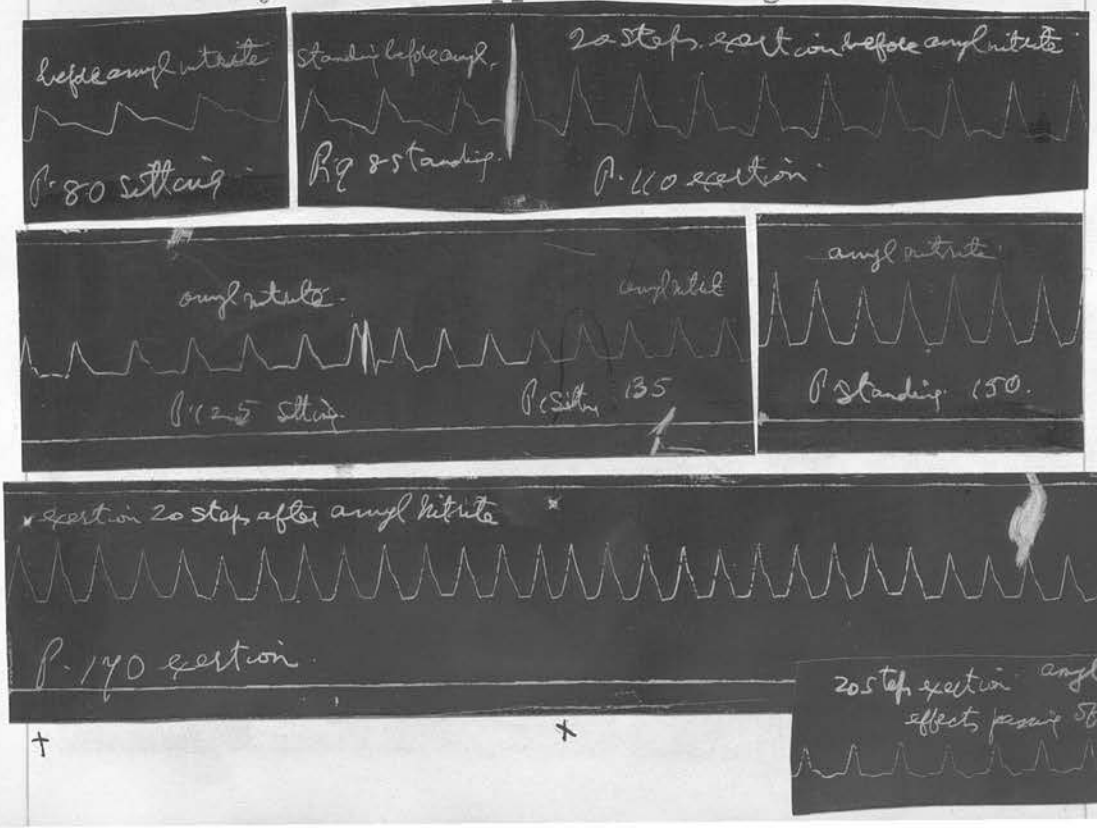

Fig 6. Note the great reduction of tension. I should have thought that a greater change would have taken place in the pulse on climbing 20 steps while under the influence of Amyl Nitrite, but the pulse has become faster and some of the beats especially those marked by a cross are almost monocrotic. Ewart (7) and Lewis (8) give examples of pulses affected by Amyl Nitrite, but I don't hold with Lewis when he calls the pulse waves with a flattened diastole, monocrotic. I had expected that the Respiratory irregularity and diastolic variations would have been greater on exertion.

3. WARM BATHS.

Edgecombe and Bain (9) and others have studied the effects of warm baths on the circulation, and the general opinion is that they cause a reduction of blood pressure. However it is conceivable, that in conditions of very low pressure warm baths might raise the blood pressure by stimulating the Heart. The following tracings were taken before and during a warm bath and under conditions as similar as possible.

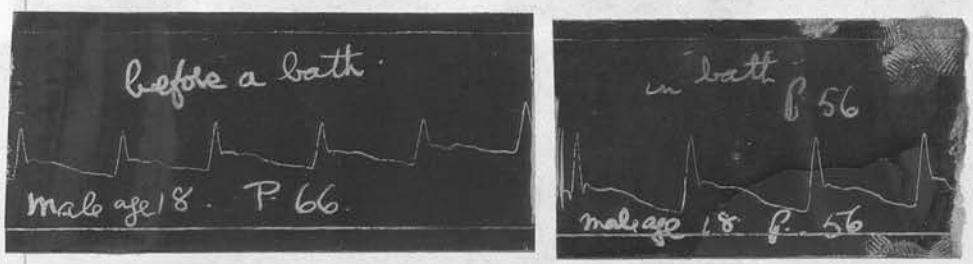

Fig 7. Male, age 18. (Before Bath (During Bath
(Pulse Sitt. 66 (Pulse sitt. 56
(Sys. Press. 130 (Syst. Press. 115.

Note the larger volume of the pulse. It will be seen that the effect of the warm bath was to lower the blood pressure and reduce the pulse rate.

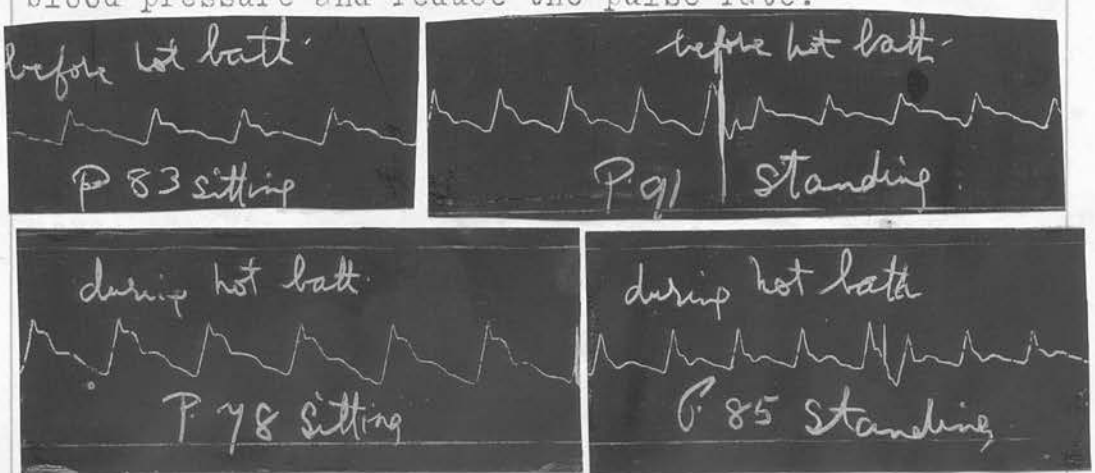

Fig 8. Male, age 30. In this case the pulse is also reduced in rate and increased in volume; the blood pressure was not estimated. The fall of pressure on standing is more pronounced while having the hot bath. My opportunities in this sphere have been strictly limited.

4. SMOKING.

Gibson (10) and Russell (11) represent the general consensus of opinion when they say that tobacco smoking raises the blood pressure.

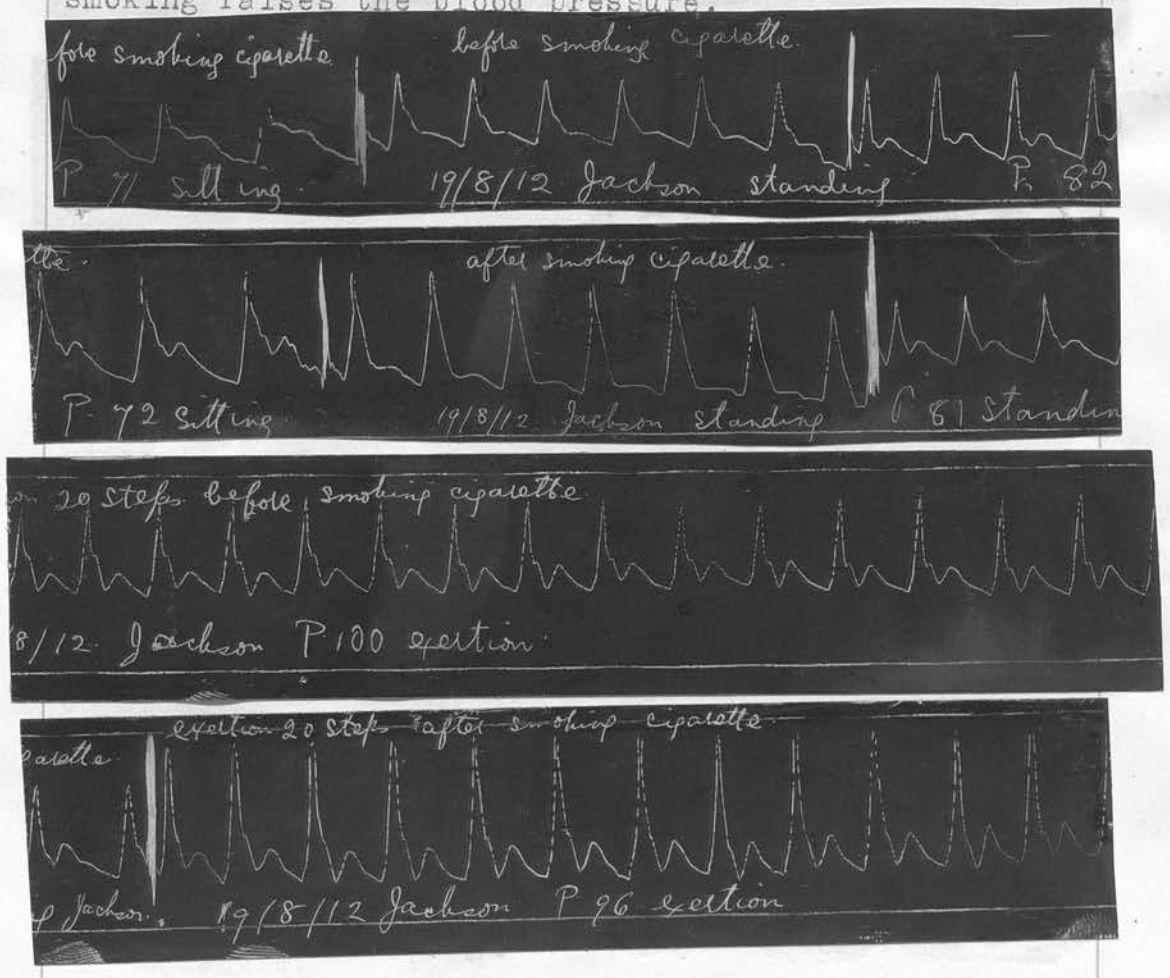

Fig 9. The tracing was taken from a youth aged 18, who has just consumed, if not quite "his first cigarette" to all intents and purposes, his first. It will be seen that the pulse has not increased in rate, but he was soon conscious of a general throbbing and the distinct fall of pressure immediately on standing after smoking, coincided with a giddy feeling induced by the tobacco. On exertion the volume of the pulse is larger; and the systole is more sudden, and the fall of pressure at the end of systole lower. There is also a slight tendency to hyperdicrotism and this is brought about without any acceleration of the rate. McKenzie

(12) believes that the difference between a fully dicrotic and hyperdicrotic pulse is merely a difference in rate, but in this and in other cases I have noted a tendency to hyperdicrotism, where the rate was not increased, but where some change had occurred causing a more sharp and sudden systole. I don't suggest that it is a hyperdicrotic pulse, but it more nearly approaches it than the pulse before smoking.

10

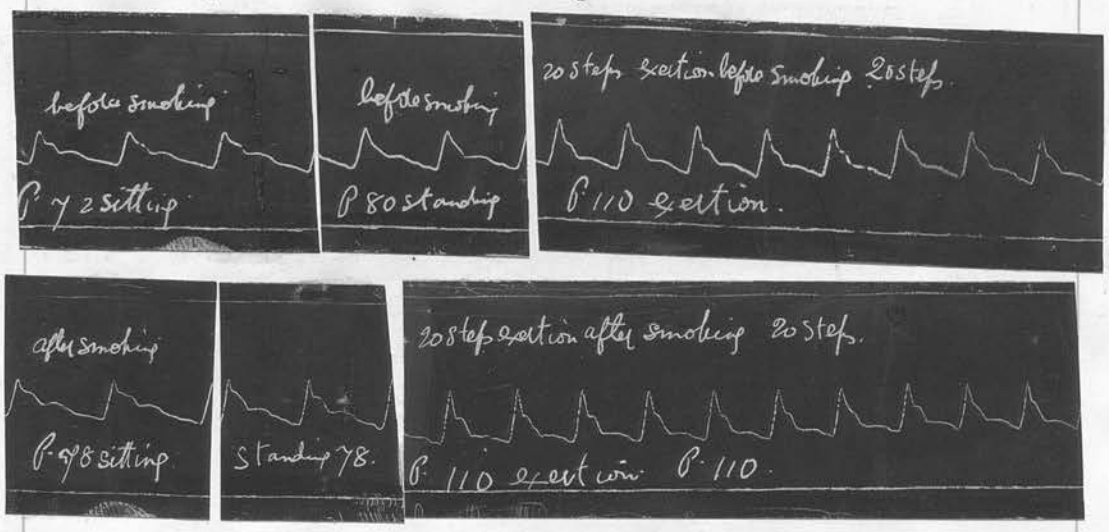

Fig 10. Male age, 30: after smoking 2 cigarettes. The change is not great, but on exertion after smoking the pulse wave is more sudden and the pressure during diastole is not so well maintained.

Before Smoking.	After Smoking.
(Systolic Press. sitt. 125.	(Systolic Press. sitt. 130.
(Dias. " " 80.	(Diast. " " 90.

A practised smoker said that smoking in the early morning before breakfast induced a "fainty" feeling on suddenly standing, and a beer drinker suffering from Aortic Incompetence said that, "Beer went to his head" much quicker if drinking and smoking were associated.

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C O N T E N T S.

THE EFFECT OF POSTURE, EXERTION AND OTHER AGENTS ON THE CIRCULATION.

Thesis for M. D. Degree, January 1913.

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